นิพนธ์ต้นฉบับ • Original Article

การศึกษาสัณฐานวิทยาแขนงหลังของเส้นประสาทแมนดิบูลาร์ในศพดองคนไทย

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A Morphological Study of Posterior Divisional Branches of the Mandibular Nerve in Embalmed Thai Cadavers

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หลักการและวัตถุประสงค์ : เส้นประสาทแมนดิบูลาร์เป็นแขนงสำคัญที่ส่งแขนงประสาทไปรับความรู้สึกรวมไปถึงสั่งการโครงสร้างบริเวณแอ่งใต้ขมับและภายในช่องปาก ในทางคลินิกความผิดปกติของทางเดินเส้นประสาทเป็นสิ่งที่ควรระวังก่อนการผ่าตัดบริเวณใบหน้าและขากรรไกร วัตถุประสงค์ของการศึกษานี้เพื่อศึกษาสัณฐานวิทยาของเส้นประสาทแมนดิบูลาร์ แขนงหลังในศพดองคนไทย

วิธีการศึกษา : ศึกษาในศีรษะผ่าซีกจำนวน 70 ข้างในศพดองคนไทย 55 ร่าง แล้วทำการผ่าศึกษาสัณฐานวิทยาของเส้นประสาทแมนดิบูลาร์แขนงหลัง

ผลการศึกษา : ระยะห่างระหว่าง lingual nerve (LN) กับด้าน mesial และด้าน distal ของฟันกรามซี่ที่สองประมาณ 11.18 ± 2.78 และ 11.16 ± 2.48 มม. ระยะระหว่างมุมล่างของ lateral pterygoid plate กับ LN คือ 7.52 ± 2.57 มม. ระยะระหว่างจุดตัดกันจากมุมล่างของ lateral pterygoid plate และจุดแยกระหว่าง LN กับ inferior alveolar nerve (IAN) คือ 10.71 ± 3.38 มม. และระยะระหว่างจุดแยกของ LN กับ IAN กับช่อง ovale คือ11.60 ± 4.12 มม. การแตกแขนงของ LN กับ IAN แบบที่ 1 พบร้อยละ 95.71 แบบที่ 2 พบร้อยละ 4.29 การเชื่อมกันระหว่างเส้นประสาทแมนดิบูลาร์แขนงหลังมี 5 แบบโดยแบบที่ 1(LN กับ IAN) พบมากที่สุดร้อยละ 10

สรุป : ผลการศึกษาจะเป็นข้อมูลพื้นฐานที่ใช้ในการพิจารณาก่อนทำการผ่าตัดบริเวณใบหน้า ขากรรไกรและการทำหัตถการเกี่ยวกับฟัน

Background and objective: The mandibular nerve branches (MNs) are the important nerves which supply structures in the infratemporal fossa and oral cavity. Clinically, the nerve variations must be aware before maxillofacial surgeries. This study aimed to investigate morphology of the MNs posterior division in embalmed Thai cadavers.

Methods: Seventy corpse halves heads of fifty-fifth embalmed Thai cadavers were carefully dissected to observe the morphology of the MNs posterior division.

Results: The results shown that the distances from mesial and distal lower second molar to the LN were approximately 11.18 ± 2.78 and 11.16 ± 2.48 mm., respectively. Three distances between LN and inferior angle of lateral pterygoid plate, intersection point between inferior angle of lateral pterygoid plate and bifurcation of the LN and IAN were 7.52 ± 2.57and 10.71 ± 3.38 mm., and distance between bifurcation of the LN and IAN to foramen ovale (FO) was 11.60 ± 4.12 mm. This study found that two types of LN and IAN bifurcation, type I: 95.71 % and type II: 4.29 %. There were five types of communication between MNs posterior division and type I (LN and IAN) was mostly found (10%) in this study.

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คำสำคัญ : เส้นประสาทแมนดิบูลาร์แขนงหลัง, เส้นประสาทลิงกวล, เส้นประสาทอินฟีเรียร์อัลวีโอลาร์, ฟันกรามซี่ที่สอง

Conclusions: These results are the basic data that may be considered before maxillofacial operations and dental treatment.

Keywords: mandibular nerve branches posterior division, lingual nerve, inferior alveolar nerve, lower second molar

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Introduction

The mandibular nerve and it branches are branch of the trigeminal nerve. These nerves supply the areas of the infratemporal fossa (ITF) and oral cavity. The variations of these nerves have been reported among different races[1-6]. Clinically, the complications of the MNs are considered during dental procedures such as LN palsy, paresthesia, dysesthesia, gustatory dysfunction, and loss of sensation[7-10]. Thus, the surgeons must be aware the variations of these nerves during maxillofacial surgeries. The variant MNs such as the communication between MNs especially the bifurcation between the LN and IAN have been reported in many races. However, there were few only reports in Thai population [2]. This study aimed to investigate the morphology of MNs posterior division in embalmed Thai cadavers.

Materials and Methods

Materials

This study was performed in 70 corpse halves heads of fifty-fifth embalmed Thai cadavers (range = 45 – 87 years old and mean age = 62.28 years) perfused with formaldehyde fixative. The specimens were performed in gross anatomy laboratory room, department of Anatomy, faculty of Medicine, Khon Kaen university.

Methods

In all specimens, the heads were opened by using a high speed drill and a rongeur in midsagittal line. The specimens were dissected from medial to lateral aspects. At the lower second molar region, specimens were carefully dissected to measure the distances from lower second molar (mesial and distal aspect) to LN in vertical line (Fig.1). The medial pterygoid muscle (MPt) was reflected to identify MNs posterior division and measure the distance between LN and the associate structures in the ITF area. The lateral pterygoid muscle (LPt) was removed to observe the furcating patterns of the LN and IAN. Three measurements were then performed; 1) Between the inferior angle of lateral pterygoid plate to LN in the horizontal direction, 2) Intersection point between the inferior angle of lateral pterygoid plate and bifurcation of the LN and IAN, and 3) Between the bifurcation of LN and IAN to FO on the base of skull.

The furcation patterns of the LN and IAN were classified into four types as Kim et al [4] and the landmarks were referenced to imagine horizontal line which was bisected the distance between the mandibular notch and the mandibular lingula.

The furcating patterns between LN and IAN were classified as follows; type I: bifurcation above the mandibular notch, type II: bifurcation in the upper half between the mandibular notch and the mandibular lingula, type III: bifurcation in the lower half between the mandibular notch and the mandibular lingula, and type IV: bifurcation present at the level of mandibular lingula. In addition, the communications between the MNs posterior division and the relationship among the IAN, inferior alveolar artery (IAA) and inferior alveolar vein (IAV) before entering to the mandibular foramen (MF) were observed.

Data Analysis

All measurements were performed by using digital calipers. The student's t-test was applied for statistical significant differences ($p < 0.05$).

Results

Interestingly, this study was created the new distance measurement from lower second molar (mesial and distal aspects) to LN in vertical direction. Moreover, the new landmark of the inferior angle of lateral pterygoid plate was developed for distance measurement to LN in horizontal direction, and the intersection point between inferior angle of lateral pterygoid plate and bifurcation of the LN and IAN as shown in Fig. 2. The average distances between LN and the adjacent structures in the lower second molar and infratemporal regions were shown in table 1. Moreover, these results showed no statistical significance differences between LN and associate structures distances and genders.

In this study, the furcation patterns of the LN and IAN were only observed in type I [95.71 % (67sides)] (Fig. 3) and type II [4.29% (3 sides)] (Fig. 4).

In addition, this study was classified the communications of the MNs posterior division into five types as shown in Fig. 5. This study found that type I (10 %): between LN and IAN, type II (1.42%): between LN and trunk of MN, type III (7.14 %): between IAN and auriculotemporal nerve, type IV (1.42%): between LN and hypoglossal nerve, and type V (1.42%): between trunk of the mandibular nerve and chorda tympani, respectively.

Moreover, this study found that two types of the relationship among the IAN, IAA and IAV (from anteroposterior) before entering to the MF. There were type I (IAN, IAA and IAV = 97.11%) and type II (IAA, IAN and IAV= 2.89%).

Discussions

The relationship of anatomical structures in the ITF makes any procedures executed in this region very complex. Moreover, differences in these average measurements show a clear distinction between races[3, 4]. The average distance between the bifurcation of LN and IAN to FO in this study (11.6 ± 4.12 mm.) was shorter than the study of Kim et al[4].

In the textbooks of anatomy, generally, describe that the LN runs in a course and divides from the mandibular nerve above mandibular notch[11]. In this study, the LN and IAN bifurcated above the mandibular notch (type I) in 65.6% of cases. In the others, the bifurcation was located at the upper half of the mandibular ramus between the mandibular notch and mandibular lingula (type II) in 4.29 % of case. In this study, type I of the furcation patterns of the LN and IAN was mostly found which was similar to other reports in Korean and Turkish[3, 4].

Table 1 Showing the distances between LN, bifurcation of the LN and IAN and the adjacent structures

The distances between LN and adjacent structures	Average distances (mm.)				
	Right side		Left side		Both sides
	Male	female	male	female	
Mesial aspect of lower second molar to the LN	12.04 ± 3.08	11.09 ± 2.29	10.17 ± 1.89	11.28 ± 2.76	11.18 ± 2.78
Distal aspect of lower second molar to the LN	11.68 ± 3.22	10.77 ± 1.85	11.16 ± 1.73	10.87 ± 1.84	11.16 ± 2.48
Inferior angle of lateral pterygoid plate to LN	7.55 ± 3.13	7.59 ± 1.92	7.31 ± 1.90	7.66 ± 2.65	7.52 ± 2.57
Inferior angle of lateral pterygoid plate to intersection point between inferior angle of lateral pterygoid plate and bifurcation of the LN and IAN	10.15 ± 2.84	9.99 ± 3.06	12.38 ± 3.73	10.58 ± 3.65	10.71 ± 3.38
Bifurcation of LN and IAN to FO	11.72 ± 3.36	10.66 ± 4.04	13.12 ± 5.17	10.83 ± 3.76	11.60 ± 4.12

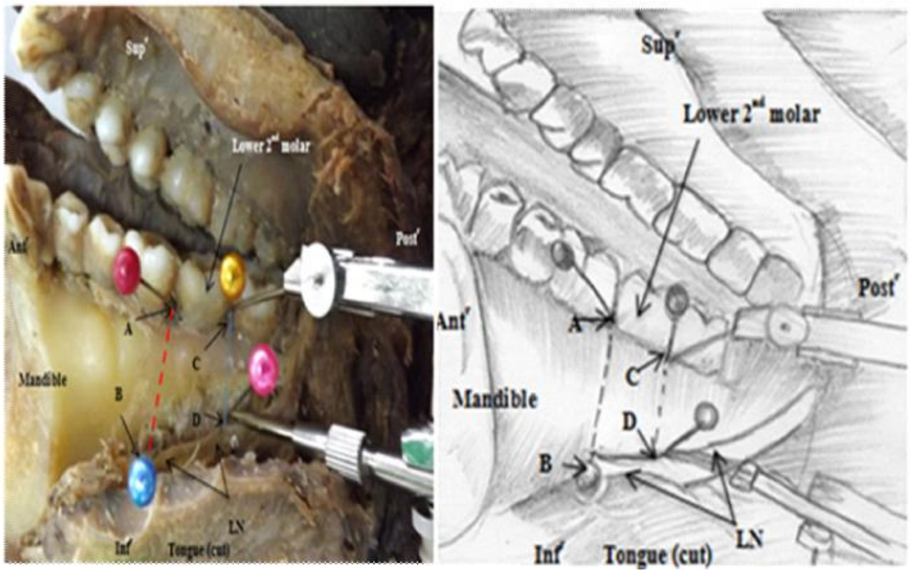

Figure 1 Showing the distance measurements from lower second molar (mesial and distal aspect) to LN in vertical line; LN = lingual nerve, A and C= mesial and distal aspect of lower second molar, B and D = superior margin of the LN, Sup^r = superior, Inf^r = inferior, Ant^r= anterior, Post = posterior

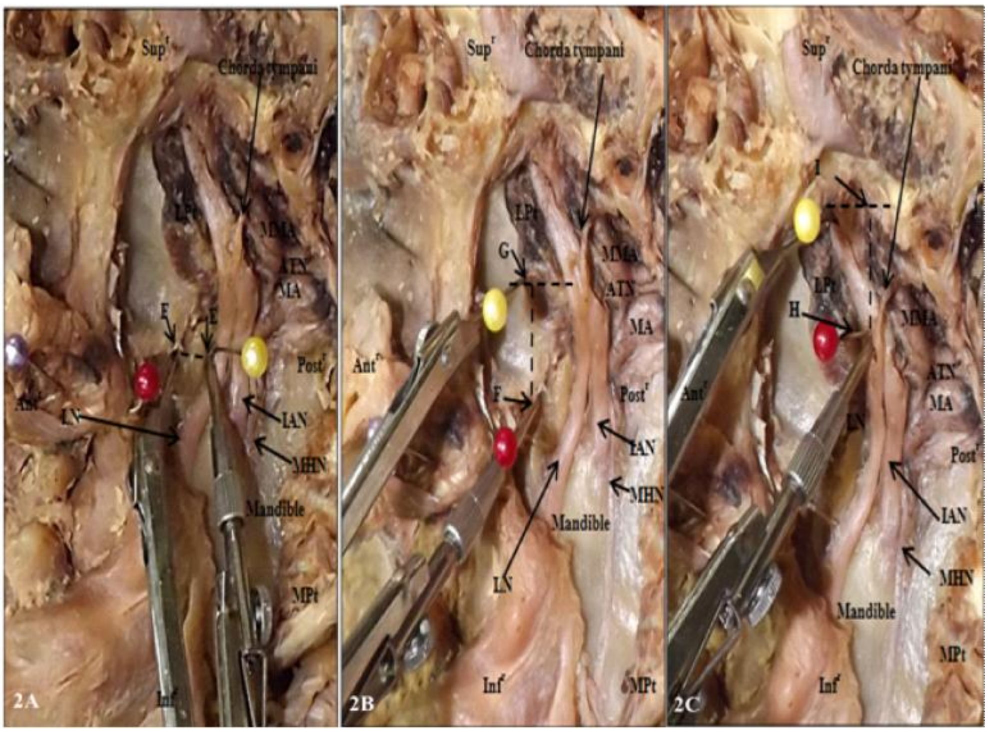

Figure 2 Showing three distance measurements; the distance from inferior angle of lateral pterygoid plate (F) to LN (E) in the horizontal direction (2A), the distance from inferior angle of lateral pterygoid plate (F) to intersection between inferior angle of lateral pterygoid plate and bifurcation of the LN and IAN (G) in vertical direction (2B), and the distance from the bifurcation of LN and IAN (H) to FO (I) (2C).

LN = lingual nerve, IAN = inferior alveolar nerve, MHN = mylohyoid nerve, ATN = auriculotemporal nerve, MA = maxillary artery, MMA = middle meningeal artery, E = anterior margin of LN, F= inferior angle of lateral pterygoid plate, G= intersection between inferior angle of lateral pterygoid plate and bifurcation of the LN and IAN, H = bifurcation of the LN and IAN, I = foramen ovale (FO), Sup^{r} = superior, Inf^r = inferior, Ant^r = anterior, Post = posterior

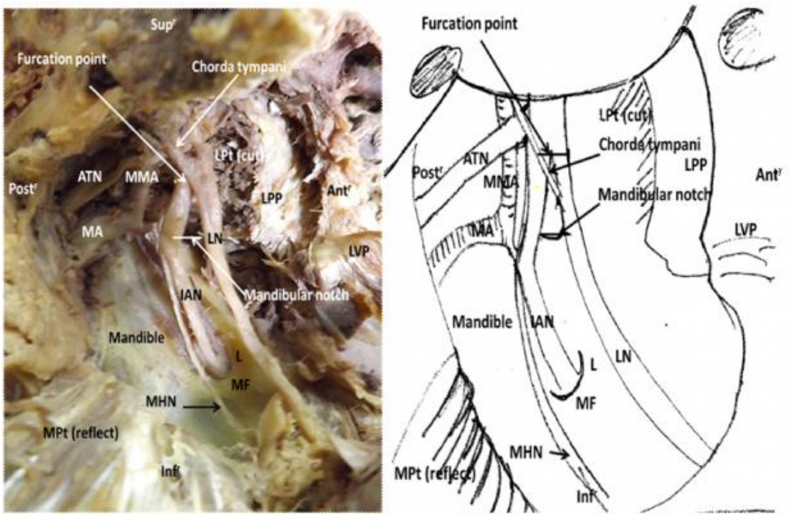

Figure 3 Showing the LN and IAN bifurcated above mandibular notch and the mandibular. LN = lingual nerve, MHN = mylohyoid nerve, IAN = inferior alveolar nerve, ATN = auriculotemporal nerve, MA = maxillary artery, MMA = middle meningeal artery, MPt. = medial pterygoid muscle, LPt. = lateral pterygoid muscle, LPP = lateral pterygoid plate, Sup^r = superior, Inf^r = inferior, Ant^r = anterior, Post = posterior

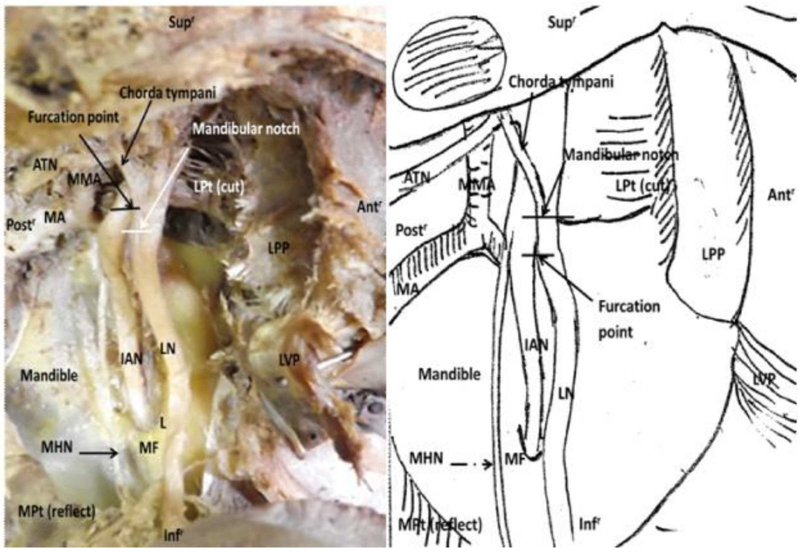

Figure 4 Showing the LN and IAN bifurcated in the upper half between the mandibular notch and the mandibular lingual (L); LN = lingual nerve, MHN = mylohyoid nerve, IAN = inferior alveolar nerve, ATN = auriculotemporal nerve, MA = maxillary artery, MMA = middle meningeal artery, MPt. = medial pterygoid muscle, LPt. = lateral pterygoid muscle, LPP = lateral pterygoid plate, Sup^r = superior, Inf^r = inferior, Ant^r = anterior, Post = posterior

In this study, five categories of variations in communication between the MNs were investigated, type I: the communication between the LN and IAN was identified in seven specimens (10%). type II (1.42%): between LN and trunk of MN, type III (7.14 %): between IAN and auriculotemporal nerve, type IV (1.42%): between LN and hypoglossal nerve, and type V (1.42%): between trunk of the mandibular nerve and chorda tympani, respectively. The existence of communication between MNs might help in the recovery other MNs injury by contributing to additional sensory innervations of their structures.

Conclusion

The anatomical variations were assumed a possible cause of complications during surgical procedures. We believe that the distribution and communication patterns of MNs posterior division, as clarified by this study, will provide a useful reference for clinical applications and surgical procedures.

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Figure 5 Showing the communication branches between LN and IAN (5A), trunk of the CN V3 and LN (5B), IAN and ATN (5C), LN and CN. XII (5D), and trunk of the CN.V3 and chorda tympani (5E); LN = lingual nerve, MHN = mylohyoid nerve, IAN = inferior alveolar nerve, ATN = auriculotemporal nerve, MA = maxillary artery, MMA = middle meningeal artery, MPt. = medial pterygoid muscle, LPt. = lateral pterygoid muscle, CN. V3 = mandibular nerve, CN. XII = hypoglossal nerve

References

1. Anil A, Peker T, Turgut HB, Gulekon IN, Liman F. Variations in the anatomy of the inferior alveolar nerve. Br J Oral Maxillofac Surg 2003; 4: 236-9.

2. Boonruangsri P, Kunatippapong N, Umka J, Pannagrong W. Topographic anatomy of mandibular nerve branches (posterior division) for maxillofacial surgery and dental advantage. *Proceedings of the 29th Annual Meeting of Anatomy Association (Thailand).* Garden Sea view Resort, Pataya, Thailand. 2nd-6th May, 2006.

3. Erdogmus S GF, Celik S. Anatomic Position of the Lingual Nerve in the Mandibular Third Molar Region as Potential Risk Factors. J Craniofac Surg 2008; 19: 264-70.

4. Kim SY, Hu KS, Chung IH, Lee EW, Kim HJ. Topographic anatomy of the lingual nerve and variations in communication pattern of the mandibular nerve branches. Surg Radiol Anat 2004; 26: 128-35.

5. Thotakura B, Rajendran SS, Gnanasundaram V, Subramaniam A. Variations in the posterior division branches of the mandibular nerve in human cadavers. Singapore Med J 2013; 54: 149-51.

6. Zur KB, Mu L, Sanders I. Distribution pattern of the human lingual nerve. Clin Anat 2004; 17: 88-92.

7. Gomes AC, Vasconcelos BC, de Oliveira e Silva ED, da Silva LC. Lingual nerve damage after mandibular third molar surgery: a randomized clinical trial. J. Oral Maxillofac. Surg 2005; 63 :1443-6.

8. Hillerup S, Jensen R. Nerve injury caused by mandibular block analgesia. Int. J. Oral Maxillofac. Surg 2006; 35: 437-43.

9. Tay AB, Zuniga JR. Clinical characteristics of trigeminal nerve injury referrals to a university centre. Int. J. Oral Maxillofac. Surg 2007; 36: 922-7.

10. Santos T AK, Santos M, Filho J. . Survey on complications of orthognathic surgery among Oral and maxillofacial surgeons. J. Oral Maxillofac. Surg 2012; 23: 423-8.

11. Bernard L. The anatomical basis of dentistry. Maryland Height Mosby Elsevier; 2011.