·论著·

# 基于锥形束CT的下牙槽神经管走行测量分析

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**【摘要】 目的** 通过锥形束CT（CBCT）分析下牙槽神经在下颌后牙区的走向。**方法** 收集2018年2月至2021年6月云南省临沧市凤庆县人民医院口腔科CBCT数据77例，对CBCT数据进行回顾性研究，将CBCT数据进行三维重建后截取左右两侧下颌第二前磨牙、第一磨牙、第二磨牙各牙根最低点的冠状面图像进行测量，包括下牙槽神经管中心点到下颌骨最下缘点的垂直距离，到处于同一水平线颊侧点的距离，到处于同一水平线舌侧点的距离，以及牙槽神经管最上缘点到根尖点的垂直距离，采用两独立样本$t$检验比较不同性别同一位点下牙槽神经管与下颌骨各方向骨壁的距离。**结果** （1）男性下牙槽神经管与下颌骨下缘间的距离大于女性。男性右下第二前磨牙位点（11.2±1.7）mm、女性为（10.2±1.2）mm，差异有统计学意义（$t$=3.123，$P$=0.003）；男性右下第二磨牙远中根位点（10.8±1.7）mm、女性为（10.1±1.6）mm，差异有统计学意义（$t$=2.133，$P$=0.036）。（2）下牙槽神经管到下颌骨颊侧骨壁的距离在第一、第二磨牙上明显大于舌侧距离。男性右下颌第一磨牙近中根位点，颊侧（6.6±1.6）mm、舌侧（3.6±1.3）mm，差异有统计学意义（$t$=9.181，$P$<0.001），女性同一位点，颊侧（6.4±1.2）mm、舌侧（3.8±1.0）mm，差异有统计学意义（$t$=9.950，$P$<0.001）；男性右下颌第二磨牙远中根位点颊侧（8.3±1.4）mm、舌侧（3.4±1.0）mm，差异有统计学意义（$t$=18.57，$P$<0.001），女性同一位点，颊侧（7.8±1.5）mm、舌侧（3.7±1.3）mm，差异有统计学意义（$t$=16.90，$P$<0.001）；在第二前磨牙上两者差距不大。除了右侧第一磨牙远中根（Ⅲ区）、右侧第一磨牙近中根（Ⅳ区）观测点外，其余观测点均可见下牙槽神经管与根尖距离上男性大于女性。**结论** 下牙槽神经管在下颌骨内的走行，在垂直向呈现一定的曲线，在颊舌向较为规律。

**【关键词】** 下牙槽神经管； 锥束计算机体层摄影术； 成像； 三维

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**Measurement and analysis of the course of the mandibular canal based on cone-beam computed tomography**

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**【Abstract】 Objective** To analyze the course of the mandibular canal in the posterior mandibular region using cone-beam computed tomography (CBCT). **Methods** The CBCT data of 77 cases in the Department of Stomatology at the People's Hospital of Fengqing County, Lincang City, Yunnan Province, from February 2018 to June 2021, were used. After three-dimensional reconstruction of the CBCT data, coronal images of the roots of the second premolars, first molars, and second molars were measured. The measurements included the vertical distance from the center of the mandibular canal to the lower margin of the mandible, to the buccal and lingual walls on the same horizontal plane, and the vertical distance from the upper margin of the mandibular canal to the apex, using an independent two-sample *t*-test to compare the distances between the alveolar nerve canal and the mandibular bone walls in males and females. **Results** The distance between the mandibular canal and the lower margin of the mandible was greater in males than that in females. This distance at the right lower second premolar point was (11.2 ± 1.7) mm in males, and (10.2 ± 1.2) mm in females, which was statistically different between genders ($t = 3.123$, $P = 0.003$). The distance at right lower second molar distal root point was (10.8 ± 1.7) mm in males, and (10.1 ± 1.6) mm in females, which was statistically different between genders ($t = 2.133$, $P = 0.036$). The distance from the mandibular canal to the buccal wall of the mandible was significantly longer than that to the lingual wall at the first and second molars, with the exception of the second premolars. The distance at the buccal side of the distal root point of the lower right first molars in males was (6.6 ± 1.6) mm, and the distance at the lingual side was (3.6 ± 1.3) mm, which was statistically different between the two sides ($t = 9.181$, $P < 0.001$). The distance at the buccal side in females was (6.4 ± 1.2) mm, and at the lingual side was (3.8 ± 1.0) mm, which was statistically different between the two sides ($t = 9.950$, $P < 0.001$). The distance at the buccal side of distal root point of the lower right second molars in males was (8.3 ± 1.4) mm, and the distance at the lingual side was (3.4 ± 1.0) mm, which was statistically different between the two sides ($t = 18.57$, $P < 0.001$). This distance at the buccal side in females was (7.8 ± 1.5) mm, and the distance at the lingual side was (3.7 ± 1.3) mm, which was statistically different between the two sides ($t = 16.90$, $P < 0.001$). The distance from the mandibular canal to the apex was longer in males than that in females on the other observation points except for the distal roots of the right first molars (Zone Ⅲ), and the mesial roots of the right first molars (Zone Ⅳ). **Conclusion** The course of the mandibular canal within the mandible exhibited a certain curve in the vertical direction, with a more regular pattern in the buccolingual direction.

**【Key words】** Mandibular canal; Cone-beam computed tomography; Imaing; Three-dimensional

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下牙槽神经管(下颌管)是下颌骨内容纳下牙槽神经血管束的密质骨管道,起于下颌孔,止于颏孔。口腔临床操作中涉及下牙槽神经管的手术,如下颌后牙拔除术、牙槽外科手术、种植手术、骨折固定手术及正颌手术等均可能对下牙槽神经管内的动静脉及神经造成直接或间接的损伤,引起相应的并发症[1-6]。下牙槽神经损伤引起的功能障碍可分为暂时性和永久性两种,影响患者生活质量,出现下颌牙、黏膜和下唇皮肤的麻木或疼痛等感觉异常,部分患者可因下唇感觉丧失引起唇自发性咬伤[6-8]。因此,了解下牙槽神经管在下颌骨内的走形具有重要的临床意义。

下牙槽神经管解剖走行的研究方法包括尸体解剖、曲面断层片和螺旋CT等[9]。锥形束CT(cone-beam computed tomography,CBCT)由于分辨率高、骨组织成像较好和放射剂量低等优点,成为近年来研究下牙槽神经管解剖的重要手段[10-13]。本研究采用CBCT进行回顾性研究,对77例下牙槽神经管的走行进行测量分析,为减少口腔临床操作并发症提供依据。

## 资料与方法

一、研究对象

收集2018年2月至2021年6月云南省临沧市凤庆县人民医院口腔科CBCT数据共计77例,其中男39例、女38例,年龄20～65岁,平均32岁。

1. 纳入标准:20岁以上成年人,双侧下颌骨基本对称无明显畸形,无下颌骨手术及外伤史,无金属修复体,CBCT图像清晰无变形,下颌后牙牙根发育已完成者,图像数据完整显示两侧下颌第二前磨牙、第一磨牙和第二磨牙各观测位点的下颌骨者。

2. 排除标准:患有骨代谢相关疾病如骨质疏松症,患中重度牙周炎,下牙槽神经管出现分支等变异,存在融合根[14-17]。

二、方法

1. CBCT扫描:嘱研究对象站立,保持头位固定,使眶耳平面与地平面基本平行,采用口腔颌面CBCT[卡瓦盛邦(上海)牙科医疗器械有限公司]进行拍摄。CBCT扫描参数设定为:电压90 kV、电流5.00 mA,

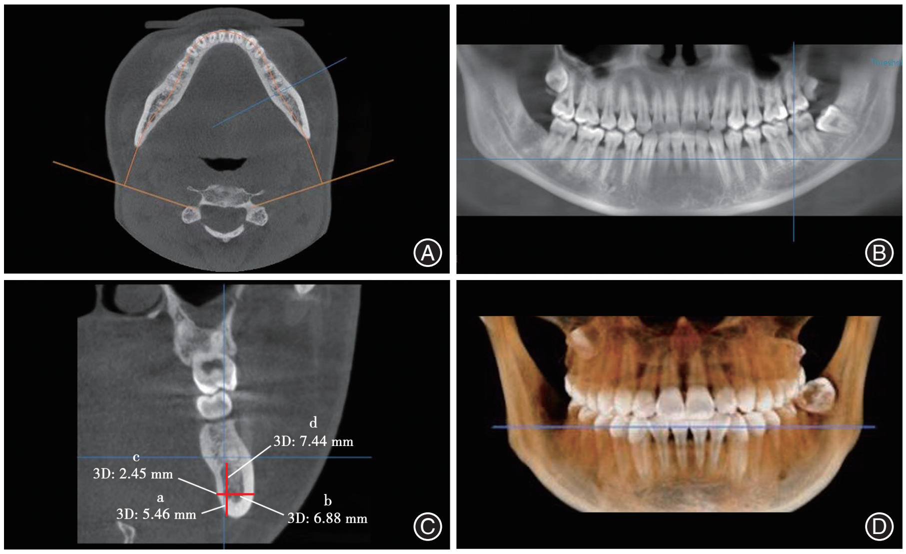


**图1** 锥形束CT(CBCT)测量示意图 A:目标测量位点的CBCT横断面(线条为重建部位);B:CBCT重建全景图;C:目标测量位点的CBCT冠状面,各位点测量内容包括:(a)下牙槽神经管中心点到下颌骨最下缘点的垂直距离(mm),(b)下牙槽神经管中心点到处于同一水平线颊侧点的距离(mm),(c)下牙槽神经管中心点到处于同一水平线舌侧点的距离(mm),(d)下牙槽神经管最上缘点到根尖点的垂直距离(mm);D:CBCT三维重建图。

分辨率0.25 mm × 0.25 mm。使用OnDemand3D™软件进行图像分析。

2. 测量位点:将拍摄到的CBCT数据进行三维重建,截取左右两侧下颌第二前磨牙、第一磨牙、第二磨牙各牙根(排除融合根)最低点冠状面图像进行测量。将右下颌第二前磨牙位点定位Ⅰ区,右下颌第一磨牙近中根为Ⅱ区,远中根为Ⅲ区,右下颌第二磨牙近中根为Ⅳ区,远中根为Ⅴ区,以此类推,将左侧相应位点定位Ⅵ~Ⅹ区。各位点测量内容包括:(a)下牙槽神经管中心点到下颌骨最下缘点的垂直距离;(b)下牙槽神经管中心点到处于同一水平线颊侧点的距离;(c)下牙槽神经管中心点到处于同一水平线舌侧点的距离;(d)下牙槽神经管最上缘点到根尖点的垂直距离(图1)。每间隔2周进行再次测量,取3次平均值为最后结果。

三、统计学处理方法

将所得测量结果用$\bar{x} \pm s$表示,运用统计软件SPSS 27.0.1对数据进行统计学分析,首先采用Kolmogorov-Smirnov检验行正态性检验,所得数据均符合正态分布。不同性别组间同一位点下牙槽神经管与下颌骨骨壁的距离的比较采用两独立样本$t$检验,$P < 0.05$为差异有统计学意义。

## 结 果

一、下牙槽神经管与下颌骨下缘间的距离

在所有观测的10个位点上,男性下牙槽神经管与下颌骨下缘间的距离均大于女性,其差异均有统计学意义(表1)。

**表1** 不同性别下牙槽神经管与下颌骨下缘的距离(mm,$\bar{x} \pm s$)

| 测量位点 | 性别 | | $t$值 | $P$值 |
|---|---|---|---|---|
| | 男($n$=39) | 女($n$=38) | | |
| Ⅰ区 | 11.2±1.7 | 10.2±1.2 | 3.128 | 0.003[a] |
| Ⅱ区 | 10.2±1.8 | 9.5±1.6 | 2.054 | 0.043[a] |
| Ⅲ区 | 10.1±1.6 | 9.6±1.6 | 2.073 | 0.042[a] |
| Ⅳ区 | 10.8±1.7 | 9.6±1.6 | 3.154 | 0.002[a] |
| Ⅴ区 | 10.8±1.7 | 10.1±1.6 | 2.133 | 0.036[a] |
| Ⅵ区 | 11.4±1.6 | 10.2±1.4 | 3.727 | < 0.01[a] |
| Ⅶ区 | 10.6±1.4 | 9.3±1.4 | 3.860 | < 0.01[a] |
| Ⅷ区 | 10.5±1.5 | 9.3±1.4 | 3.552 | < 0.01[a] |
| Ⅸ区 | 10.8±1.6 | 9.7±1.8 | 2.895 | 0.005[a] |
| Ⅹ区 | 11.0±1.8 | 10.1±1.8 | 2.364 | 0.021[a] |

注:男女在该位点下牙槽神经管与下颌骨下缘的距离差异有统计学意义,[a]$P < 0.05$。右下颌第二前磨牙位点定位Ⅰ区,右下颌第一磨牙近中根为Ⅱ区,远中根为Ⅲ区,右下颌第二磨牙近中根为Ⅳ区,远中根为Ⅴ区,以此类推,左侧第二前磨牙、第一磨牙近远中根、第二磨牙近远中根定位Ⅵ~Ⅹ区。

二、下牙槽神经管与颊舌侧骨皮质间的距离

双侧第一、第二磨牙的观测点上,下牙槽神经管到下颌骨颊侧骨壁的距离均明显大于舌侧距离,而在第二前磨牙上差距不大。在双侧下颌第二前磨牙(Ⅰ区、Ⅵ区)、左下颌第一磨牙近中根(Ⅶ区)和远中根(Ⅷ区)这4个观测点上,男性的下牙槽神经管与颊侧骨皮质的距离大于女性的,差异具有统

计学意义。而男女在下牙槽神经管与舌侧骨皮质的距离上的差异则没有统计学意义(表2)。

**表2** 不同性别下牙槽神经管与颊舌侧骨皮质间的距离对比($mm, \bar{x}\pm s$)

| 测量位点 | 颊舌侧 | 性别 | | $t$值 | $P$值 |
|---|---|---|---|---|---|
| | | 男($n$=39) | 女($n$=38) | | |
| Ⅰ区 | 颊侧 | 5.3±1.2 | 4.6±0.9 | 2.629 | 0.010[a] |
| | 舌侧 | 4.7±1.3 | 5.0±1.0 | −1.176 | 0.243 |
| Ⅱ区 | 颊侧 | 6.6±1.5 | 6.4±1.2 | 0.620 | 0.537 |
| | 舌侧 | 3.6±1.3 | 3.8±1.0 | −0.604 | 0.547 |
| Ⅲ区 | 颊侧 | 7.3±1.6 | 6.9±1.2 | 1.293 | 0.200 |
| | 舌侧 | 3.4±1.1 | 3.6±1.0 | −0.642 | 0.523 |
| Ⅳ区 | 颊侧 | 8.3±1.4 | 7.8±1.5 | 1.824 | 0.072 |
| | 舌侧 | 3.4±1.0 | 3.7±1.3 | −1.089 | 0.280 |
| Ⅴ区 | 颊侧 | 8.4±1.4 | 8.1±1.4 | 1.007 | 0.123 |
| | 舌侧 | 3.4±1.0 | 3.6±1.0 | −0.899 | 0.371 |
| Ⅵ区 | 颊侧 | 5.0±1.1 | 4.4±1.1 | 2.574 | 0.012[a] |
| | 舌侧 | 5.0±1.6 | 5.0±1.3 | −0.133 | 0.894 |
| Ⅶ区 | 颊侧 | 6.6±1.5 | 5.9±1.1 | 2.128 | 0.037[a] |
| | 舌侧 | 3.8±1.3 | 3.9±1.1 | −0.351 | 0.727 |
| Ⅷ区 | 颊侧 | 7.3±1.4 | 6.6±1.2 | 2.087 | 0.040[a] |
| | 舌侧 | 3.6±1.1 | 3.7±1.1 | −0.722 | 0.472 |
| Ⅸ区 | 颊侧 | 8.1±1.4 | 7.6±1.4 | 1.451 | 0.151 |
| | 舌侧 | 3.6±1.1 | 3.7±0.9 | −0.672 | 0.504 |
| Ⅹ区 | 颊侧 | 8.1±1.6 | 8.0±1.5 | 0.278 | 0.782 |
| | 舌侧 | 3.9±1.6 | 3.7±1.0 | 0.531 | 0.597 |

注:男女在该位点下牙槽神经管与颊舌侧骨壁的距离差异有统计学意义,[a]$P<0.05$。右下颌第二前磨牙位点定位Ⅰ区,右下颌第一磨牙近中根为Ⅱ区,远中根为Ⅲ区,右下颌第二磨牙近中根为Ⅳ区,远中根为Ⅴ区,以此类推,左侧第二前磨牙、第一磨牙近远中根、第二磨牙近远中根定位Ⅵ~Ⅹ区。

三、下牙槽神经管与根尖的距离

在右侧第一磨牙远中根(Ⅲ区)、右侧第一磨牙近中根(Ⅳ区)的观测点上,不同性别间下牙槽神经管与牙根尖的距离差异没有统计学意义。其他观测位点上,男性的下牙槽神经管距离牙根尖均大于女性,差异具有统计学意义(表3)。下牙槽神经管在垂直方向上的走向趋势如图2所示。

## 讨　论

由于CBCT骨组织显像较好、分辨率高,并且可提供三维重建影像[18-21],本研究采用CBCT对下牙槽神经管在不同位点上与下颌骨各骨壁之间距离进行测量分析。然而,CBCT对软组织成像欠佳,无法直接观察下牙槽神经,并且由于设备及观测者本身的原因,可能会遗漏一些细小分支[22-23]。

**表3** 不同性别下牙槽神经管与各牙牙根尖的距离对比($mm, \bar{x}\pm s$)

| 测量位点 | 性别 | | $t$值 | $P$值 |
|---|---|---|---|---|
| | 男($n$=39) | 女($n$=38) | | |
| Ⅰ区 | 4.7±2.7 | 3.6±2.1 | 2.075 | 0.041[a] |
| Ⅱ区 | 6.4±3.0 | 4.9±2.9 | 2.135 | 0.036[a] |
| Ⅲ区 | 5.8±2.9 | 5.1±2.4 | 1.184 | 0.240 |
| Ⅳ区 | 4.8±2.8 | 3.9±2.5 | 1.523 | 0.132 |
| Ⅴ区 | 4.5±3.1 | 3.0±2.4 | 2.406 | 0.019[a] |
| Ⅵ区 | 4.8±2.3 | 3.5±2.0 | 2.687 | 0.009[a] |
| Ⅶ区 | 5.9±2.2 | 4.9±2.3 | 1.152 | 0.035[a] |
| Ⅷ区 | 5.8±2.6 | 4.7±2.4 | 2.016 | 0.047[a] |
| Ⅸ区 | 4.7±2.2 | 3.7±2.1 | 2.066 | 0.042[a] |
| Ⅹ区 | 4.3±2.6 | 2.9±2.3 | 2.610 | 0.011[a] |

注:男女在该位点下牙槽神经管与牙根根尖的距离差异有统计学意义,[a]$P<0.05$。右下颌第二前磨牙位点定位Ⅰ区,右下颌第一磨牙近中根为Ⅱ区,远中根为Ⅲ区,右下颌第二磨牙近中根为Ⅳ区,远中根为Ⅴ区,以此类推,左侧第二前磨牙、第一磨牙近远中根、第二磨牙近远中根定位Ⅵ~Ⅹ区。

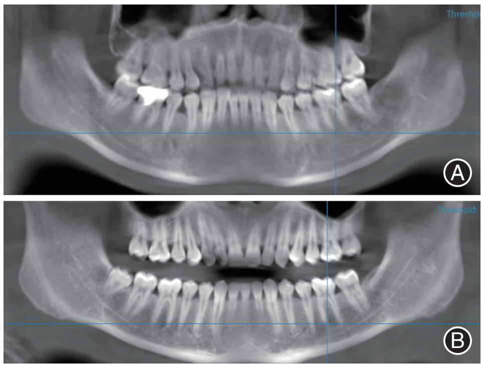


**图2** 锥形束CT显示下牙槽神经管在垂直方向上的走向趋势　A:病例1;B:病例2。

本研究收集样本量相对不足,各年龄段分布不均,未进行年龄分组,后续拟收集更多病例后按青年、中年、老年分组进行测量,以期分析不同年龄组下牙槽神经管不同走行。此外,由于收集病例中下颌第三磨牙因阻生拔除者较多,本研究未进行第三磨牙位点处下颌神经管位置的测量,研究结果对于涉及该部位的相关牙槽外科操作缺乏指导意义。

本研究结果显示,男性下牙槽神经管距离下颌下缘明显大于女性,与国外研究结果一致[24-27],但与戴慧颖[28]的研究结果不同。笔者分析,一方面可能是地域及种族差异的体现,另一方面,此项测量结果与研究采用的CBCT分辨率及测量者的主观差异有关。与上述研究不同的是,本研究选取的测量位点为下颌后牙牙根对应的截面,对于根管治疗、种植手术等更具有临床指导意义。值得注意的是,本

研究结果显示,下牙槽神经管与距离下颌骨下缘的距离,在前磨牙区最大,其次是第二磨牙,最后才是第一磨牙。可见,下牙槽神经管在下颌后牙区的走行并非直行向下,因此在外科手术过程中应注意其行径,避免造成神经损伤。

在颊舌向,下颌神经管与颊侧的距离从前往后递增,可见其走行偏向舌侧,这与Chua等[29]和Khorshidi等[30]的研究一致。下牙槽神经管在前磨牙区趋向居中位置,而在磨牙区则呈现明显的偏向舌侧,这对于种植体植入角度的选择及牙槽外科入路等手术有重要的临床意义。与垂直向明显的性别差异不同,颊舌向的性别差异不明显,只在部分位点体现,且两者差距不大。

下牙槽神经管与牙根尖的距离,同样呈现一定的曲折路线,从前往后距离先增大后变小[31]。因此在行根管治疗及阻生牙、多生牙拔除等手术过程中,要特别注意其走行。总体而言,男性此距离较女性为大,因此建议术前拍摄CBCT准确判断下牙槽神经管位置与牙根关系,防止误伤。

综上所述,下牙槽神经管在下颌骨内的走行,在垂直方向呈现一定的曲线,在颊舌向较为规律,但性别差异则更多地体现在垂直方向上。

**利益冲突** 所有作者均声明不存在利益冲突

**作者贡献声明** 王世美、薛超:实验操作、论文撰写;李志鹏:数据整理、统计分析;蔡伟鑫:研究指导、论文修改

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