The Probability of Lingual Plate Perforation of Immediate Virtual Implant Placement on Mandibular Posterior Teeth: A Preliminary Study

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Immediate placement of a dental implant into a fresh extraction socket has got attention in recent days. Immediate dental implant placement has been shown to be a successful treatment procedure; however, it is still technically challenging and can be considered as a “technique-sensitive” procedure. Therefore, the clinician should always be aware that certain untoward risks and complications have been reported, such as immediate implant placement beyond the alveolar housing may result in perforation of the lingual cortex, damaging vital anatomical structures and causing neurovascular injuries. When lingual plate perforation (LPP) occurs in the posterior mandible region, it may result in inflammation and/or infection that could adversely influence the outcome of the immediate implant placement, and may even cause life-threatening events. The purposes of the present computer simulation study are to evaluate the prevalence of, and the dimensional parameters of lingual concavities, and to determine whether the presence of lingual concavities is related to a higher risk of LPP when performing an immediate implant surgery in the mandibular posterior region. The cone beam computed tomographic images from 200 subjects (856 teeth) were analyzed in regards to the shape of the mandible (C, P, U Type), dimensional parameters of lingual concavity (angle, height, depth), and determine the probability of LPP by virtual implant placement.

The overall probability of LPP is 14.5%, with the mandibular second molar (38.3%) representing the highest risk for LPP compared to the other tooth types (p < 0.001). It should be noted that the tooth type, shape of the mandible, and dimensional features of lingual concavities are all associated with risks of LPP during immediate implant placement. (J Taiwan Periodontol, 20(2):91-102, 2015)

Keywords: immediate implant, lingual plate perforation, lingual concavity
Introduction

Dental implants have become an indispensable treatment option for patients who have subsequently lost tooth functions and suffer from pronunciation, aesthetic, biting, or chewing dysfunctions due to missing teeth. According to the initial treatment protocols recommended by Branemark et al., a patient must wait from 6 to 12 months after tooth extraction for alveolar bone remodeling before an implant surgery can be performed. After that, 3 to 6 months will be needed so that the alveolar bone may complete osseointegration, then soft tissue surgery and subsequent denture prosthesis treatments can subsequently be performed. The treatment process after tooth extraction often takes over a year of treatment time. Patients must also face functional and aesthetic losses caused by missing teeth during this period. This treatment procedure has been continuously revised by various scholars since its proposal by Branemark et al. Therefore, exceedingly more surgical methods and studies have focused on the topics of how to decrease the number of operations and shorten the postoperative bone remodeling and osseointegration time. For example, immediate implant placement is a topic that has been widely discussed.

Previously studies indicated that immediate implant placement has a high satisfaction rate. Its advantages include a fewer number of operations, shortened overall treatment time, and reduced patient discomfort. Conversely, immediate implant placement has its limitations and drawbacks, which are listed as follows. (1) If immediate implant placement is performed on an infected extraction tooth socket (such as periodontal disease or extraction wound with apical lesions), the probability of postoperative infection may increase. (2) The gaps between the extraction socket and the implant may require guided bone regeneration (GBR) surgery. Dissimilar or allogeneic bone powder may also cause subsequent infection and poor healing if used, and thus increase the probability of surgical failure. (3) Initial insufficient primary stability may lead to early implant failure. (4) It is difficult to achieve high aesthetic demand standards without subsequent soft tissue grafts. (5) Immediate implant placement at the mandible posterior regions may cause infection and eventually result in implant failure if the implant has protruded through the outer bundaries of the mandible bone. Worse still, this condition may damage critical anatomical structure, causing nerve damage and resulting in temporary or permanent paralysis. The condition may also lead to lingual plate perforation, which cause bleeding at the floor of the mouth or even obstruct the airway and threaten the life of the patient.

Despite the drawbacks and limitations of immediate implant placement, there is still insufficient evidence to demonstrate whether immediate or the delayed implant placement is better according to the randomized comparative clinical studies that have been published. Therefore, in terms of clinical operations, surgeons should still select the appropriate objective conditions (such as alveolar bone width and height, as well as the integrity of the extraction socket and whether it is infected) to perform detailed pre-operative risk assessments, improve the rate of success for immediate implant placements, and achieve the most satisfactory postoperative results for dentists and patients.

Therefore, the objective of this study is to use image analysis software to review the images in the computer tomography image database of the Tri-Service General Hospital (TSGH) and observe the categories of alveolar bone morphology, mandibular lingual concavities, and the relevant anatomical parameters of the alveolar bone lingual concavity patterns around the mandible posterior region. We also adopted the virtual implant placement at mandible posterior teeth region to explore and assess the possibility of whether the mandible lingual plates would be perforated by an implant during a immediate implant surgery.

Materials and Methods

Source of Patients and Image Data

The source of the computer tomography images used in this study came from patients who needed implant treatment and underwent computer tomography assessment in the TSGH from August 2011 to October 2013. Basic information for the participating patients when the computer tomography images were taken includes a detailed
record of gender, age, and treatment history. All of the images were shot using a cone-beam computed tomography machine operated by professionally trained radiologists. The images we analyzed all came from the aforementioned image database. No patient was required to take the computer tomography image deliberately for this study. The image data to be analyzed were copied to a desktop computer and saved under the Digital Imaging and Communications in Medicine (DICOM) format. All of the images were screened and double-checked by two trained dentists using a 19 inch LCD screen to ensure that the analysis images meet the inclusion conditions established for the study. If the consensus were not reached by the two dentists, the dentists would then discuss with each other until a conclusion is made. The design and procedures for this study were reviewed and approved by the Institutional Review Board, Tri-Service General Hospital, National Defense Medical Center (TSGHIRB No. 2-102-05-064).

Image Inclusion and Exclusion Conditions

Image data to be included in this study must meet the following criteria:

1. Among the patients’ mandible permanent teeth, at least one second premolar must be fully grown in addition to the first molar or the second molar;
2. The roots of the mandible posterior teeth of the patients must be fully grown;
3. The patients’ alveolar nerve canal must be clear, readable, and can easily be defined;
4. The patients’ posterior teeth at the mandible must be positioned correctly without displacement or malpositioned and present a smooth occlusal plane when biting down;
5. Bite image for the patients’ maxilla teeth must be clearly visible in order to provide a suitable implant angle.

Image data are excluded under the following conditions:

1. Unclear or unrecognizable data due to scattering images or other reasons;
2. The tooth being studied has no tooth ridge or has already been replaced by artificial implant;
3. The tooth position being studied has no sufficient room or bone mass to support implant cultivation.

Measurement and Analysis Methods

All of the image data analyses and measurements were complete by one independent surveyor. The measurement region starts from the posterior area of the mandible (from the second premolar to the second molar) occlusal plane extending to the lower edge of the mandible bone. For teeth that comply with the analysis conditions, a cross-sectional image from the bone ridge center towards the buccolingual direction is made (as shown in Fig 1).

Classification of the Mandible Cross-Sectional Patterns

In this study, we analyzed the alveolar bone patterns of mandible posterior teeth, followed by Chan et al. that measured the alveolar bone patterns of the first molar region (as shown in Fig 2). The level line of the parallel occlusal surface 2 mm above the posterior teeth alveolar nerve foramen was used as line A. Line A and the lingual side intersection point is designated as the A point. The mandible bone patterns were then further classified into three types: convex type C, parallel type P, and undercut type U. If no significant lingual concavity is visible, the alveolar bones were classified as convex (type C) or parallel (type P). Type C alveolar bone base is wider than the top, but the bone ridges of a type P alveolar bone is almost parallel. For type U alveolar bones, lingual concavity depths, heights, and angles were further measured (as shown in Fig 2).

We referenced the measurement method proposed by Parnia et al. (2010) for the lingual concavity depth, height, and angle measurements. First, we draw dashed lines at the most obvious upper and lower ends of the concavity. Then we used the longest vertical line of the tangent to find the deepest points of the concavities to represent the maximum depths of the submandibular fossa and designated them as C points. In addition, the highest lingual protrusion points were designated as P points. The distance between the vertical line passing through the P point and the C point is the concavity depth, the distance between the P point and the C point horizontal line is the lingual concavity height, and the angle formed with a line passing through the P and the C points and a horizontal line passing through the C point is the lingual concavity angle.
Definition of the Virtual Implant Position and Lingual Bone Plate Perforation

We referenced Forum (2011) for our assessment into the risks related to immediate implant placement lingual bone plate perforations, which indicated that the distance between the bottom of the socket for a freshly extracted tooth and the nerve canal must be at least 6 mm apart in order to be safe\(^\text{25}\). Among them, 4 mm of the native bone is required for the implant to have primary stability, and a 2 mm distance under the posterior teeth alveolar nerve is required to serve as the safe zone\(^\text{26,27}\). Zarb et al. suggested that the diameter of an implant for the mandible posterior teeth region must be at least 4 mm wide in order to withstand sufficient bite load\(^\text{28,29}\). Therefore, this study is designed to set a 4 mm diameter virtual implant with the length of 4 mm from the tip of the root to the length of the autogenous bone to assess the risks of lingual bone plate perforation for immediate implant placements. Lingual bone plate perforation is defined as when the edge of the virtual implant exceeds the mandible cortical bone.
Results
This study comprised a total of 381 participating patients who have received computer tomography (CT) scans. The associated values were screened based on the inclusion and exclusion criteria, and total of 196 patients were eligible. Among them, 102 were male patients and 94 were female patients. The average age of the patients was 46.03 ± 14.18 years (from 20 to 84 years old). A total of 833 teeth met the inclusion and exclusion criteria, therefore, the teeth included in this study were 334 mandibular second premolars (40.1%), 241 mandibular first molars (28.9%), and 258 mandibular second molars (31.0%) (Table 1).

The qualified images were further classified according to the anatomical patterns of the alveolar bones (C, P, and U type) for further analysis. Among the 856 teeth being analyzed, the most common were U type with 372 teeth (44.7%), followed by P type with 289 teeth (34.7%), and then by C type with the least quantity of 172 (20.6%) (Table 1). According to teeth position analyses for second premolars, 115 were C type (34.4%), 139 were P type (41.6%), and 80 were U type (24.0%). For first molars, C type comprised 41 teeth (17.0%), P type comprised 67 teeth (27.8%), and U type comprised 133 teeth (55.2%). For second molars, C type comprised 16 teeth (6.2%), P type comprised 83 teeth (32.2%), and U type comprised 159 teeth (61.6%). The alveolar bone classification patterns for different teeth contain statistical differences (p < 0.001) (Table 1).

For teeth from alveolar bones classified as U type (372 teeth), we further analyzed the mandibular alveolar bone lingual concavity related anatomical parameters. The second premolars have the lingual concavity height of 10.0 ± 2.8 mm with the concavity angle of 67.8 ± 8.4 degrees and concavity depth of 0.3 ± 2.0 mm. The first molars have the lingual concavity height of 9.7 ± 3.6 mm with the concavity angle of 60.2 ± 9.6 degrees and concavity depth of 5.3 ± 1.6 mm. The second molars have the lingual concavity height of 9.9 ± 3.5 mm with the average angle of 57.8 ± 7.9 degrees and the average concavity depth of 6.1 ± 1.8 mm. Overall, the second premolars’ average concavity height and angle are greater than those of the first and second molars, but with smaller concavity depths than those of the first and second molars (Table 2).

In addition, we further conducted an anticipation comparison in this study based on teeth positions, anatomical patterns as well as relevant anatomical parameters of lingual concavity, and lingual plate perforations.

The probability for simulated implants to cause lingual plate perforations were 13.9%. When classification was made based on teeth position, the probability for simulated second premolar implants

| Table 1. Mandibular alveolar bone anatomic classification patterns (CPU) distribution |
|---|---|---|---|---|---|
| Teeth position (%) | C type | P type | U type | Total | p value |
| Mandibular second premolar | 115 (34.4) | 139 (41.6) | 80 (24.0) | 334 (100) | < 0.001 |
| Mandibular first molar | 41 (17.0) | 67 (27.8) | 133 (55.2) | 241 (100) |
| Mandibular second molar | 16 (6.2) | 83 (32.2) | 159 (61.6) | 258 (100) |
| All teeth | 172 (20.6) | 289 (34.7) | 372 (44.7) | 833 (100) |

| Table 2. Mandibular alveolar bone lingual concavity patterns related anatomical parameters (mean ± SD) |
|---|---|---|---|
| Teeth position | n | Lingual concavity height (mm) | Lingual concavity angle (°) | Lingual concavity depth (mm) |
| Mandibular second premolar | 80 | 10.0 ± 2.8 | 67.8 ± 8.4 | 4.3 ± 2.0 |
| Mandibular first molar | 133 | 9.7 ± 3.6 | 60.2 ± 9.6 | 5.3 ± 1.6 |
| Mandibular second molar | 159 | 9.9 ± 3.5 | 57.8 ± 7.9 | 6.1 ± 1.8 |
| All teeth | 372 | 9.8 ± 3.4 | 60.8 ± 9.4 | 5.4 ± 1.9 |
to cause lingual plate perforations were 3.0% (10/334), the probability for simulated first molar implants to cause lingual plate perforations were 4.1% (10/241), and the probability for simulated second molar implants to cause lingual plate perforations were 37.1% (95/258). When classification was made based on lingual alveolar bone concavity anatomical patterns, if anatomical pattern is C type, the probability for simulated implants to cause lingual plate perforations were 2.3% (4/172); if anatomical pattern is P type, the probability for simulated implants to cause lingual plate perforations were 10.8% (31/289); and if anatomical pattern is U type, the probability for simulated implants to cause lingual plate perforations were 21.7% (80/372). When lingual concavity related anatomical parameters were used for the relevant classifications, the smaller the concavity angles (55.3° ± 7.3°), the greater the probability of lingual plate perforations (p < 0.001, Table 3); the greater the concavity height (10.3 ± 2.9 mm), the greater the probability of lingual plate perforations (p = 0.172, Table 3) The greater the concavity depth (7.0 ± 1.7 mm), the greater the probability of lingual plate perforations (p < 0.001, Table 3).

**Table 3.** Expectation assessment for simulated implants to cause lingual plate perforation

<table>
<thead>
<tr>
<th></th>
<th>No</th>
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<th>Yes</th>
<th></th>
<th>p</th>
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<td>Mandibular second premolar</td>
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<td>Mandibular first molar</td>
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<td>Mandibular second molar</td>
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<td>62.90</td>
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<td>All teeth</td>
<td>714</td>
<td>86.10</td>
<td>115</td>
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<td>P type</td>
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<tr>
<td>U type</td>
<td>289</td>
<td>78.30</td>
<td>80</td>
<td>21.70</td>
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<tr>
<td>All teeth</td>
<td>714</td>
<td>86.10</td>
<td>115</td>
<td>13.90</td>
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<tr>
<td><strong>Lingual concavity anatomical parameters (mean ± SD)</strong></td>
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<td>Lingual concavity angle (°)</td>
<td>62.4 ± 9.3</td>
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<td>55.3 ± 7.4</td>
<td>&lt; 0.001</td>
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<tr>
<td>Lingual concavity height (mm)</td>
<td>9.7 ± 3.6</td>
<td></td>
<td>10.3 ± 2.9</td>
<td>0.172</td>
<td></td>
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<tr>
<td>Lingual concavity depth (mm)</td>
<td>5.0 ± 1.7</td>
<td></td>
<td>7.0 ± 1.7</td>
<td>&lt; 0.001</td>
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**Discussion**

The findings in this study indicated that among the Taiwanese ethnic group, for the molar region (including first molars and second molars), the most common lingual alveolar bone pattern is the undercut type (U type) (58.5%). However, for the premolar region, the most common alveolar bone pattern is the parallel type (P type) (41.6%) (Table 1). In addition, according to a study conducted by the Chi Mei hospital team in Taiwan, 50.0% of the Taiwanese people have undercut type mandibular first molar alveolar bones. The results of a related foreign studies conducted by Dr. Chan and others on Caucasians and African-Americans indicated that undercut type mandibular first molar alveolar bone accounted for 66%. Watanabe et al. focused on the Japanese people, and found that the undercut type mandibular first molar alveolar bone accounted for 39%. The differences between these results may be explored and analyzed in several ways: First, different races. Chan et al. primarily focused on Caucasian and African-Americans and Watanabe et al. primarily focused on the Japanese ethnicity, but this study and Taiwan Chi Mei Hospital focused on the Taiwanese people as research subjects. Second,
analyses alveolar bone lingual concavity point as the point of by Parnia et al., and set the deepest mandibular canal of the inferior alveolar nerve and point at the 2 cm level on top of the upper margin. Fourth, the size of the samples may also affect the lingual concavity statistical percentages. The larger the quantity of the samples, the closer the samples can represent the actual distribution of the Taiwanese ethnic group (Table 4).

There are few studies discussed the prevalence of lingual perforation caused by immediate implantation surgeries on posterior mandibular region. Relevant reference only comprised a case report published by Berberi (1993)\textsuperscript{[15,16]}. Leong et al. (2011) focused on placing narrow diameter implants into largely edentulous mandibular ridges, and the results indicated the lingual perforation incidence rate of approximately $0.053\%$. Forum et al. (2011) investigated the lingual perforation incidence rates of posterior mandibular simulated implants, where incidence rates were approximately 7\% for second premolars, 9\% for first molars, and 31\%\textsuperscript{[25]} second molars. Meanwhile, Chan et al. placed simulated implants into posterior mandibular teeth edentulous ridges and found the lingual perforation incidence rate of 1.1\% to 1.2\%, and that the most common happened on the undercut type\textsuperscript{[26]}. However, that study indicated that most of the simulated Implantations were only approximately 1 mm away from the outer cortical bone, so there is definitely a considerable degree of lingual perforation risks. In this study, eight hound and thirty-three teeth from 196 patients were investigated, and the analysis results indicated that the probability for a simulated implant to cause lingual perforation is 13.9\%, where the possibility for second premolar is 3.0\%, first molar is 4.1\%, and second molar is as high as 37.1\% (Table 3). Compared to previous studies, the difference between previous studies could be attributed to the tapered design implants, which reduced the lingual plate perforation incidence rate\textsuperscript{[23,25,31,34]}. These results indicated that implants for posterior mandibular with lingual concavity (except for impact from the local anatomical factors), maybe using tapered design and narrower diameter implants can reduce the potential risks of damaging the important anatomical structures\textsuperscript{[23,25,31,34]}. It is worth mentioning that implantation of shorter or narrower implants to accommodate bone factors can severely impact the implant’s initial stability. Therefore, it is recommended that the size of the implants should be appropriate, and doctors should perform guided bone regeneration surgery when necessary\textsuperscript{[35,36]}.

For long-term survival and success rate of the patients’ implants, Block et al. recommended that surgical doctors should put the longest and widest implant into the jaw bone as permitted by the bone conditions\textsuperscript{[37,38]}. However, this choice will also increase the risks for implants to damage the nerves as well as lingual plate penetrations or implant failures. Lazzara et al. indicated that to prevent the implant from damaging the inferior alveolar nerves, the bottom point of the implant tip must at least be 2 cm apart from the alveolar nerve canal in order to keep a safe distance during an immediately implant placement surgery\textsuperscript{[26]} and reduce post-surgery implant complications. However, surgeons often strive to achieve initial stability for the implants during immediate implant surgeries and will place the implantation at least 4 cm below the extracted cavity\textsuperscript{[24,29]}. Therefore we used simulated implants in this study to analyze the possibility of causing lingual perforation during posterior mandibular region immediate implant surgeries.

This study also indicated that even if there is lingual concavity, the anatomical pattern characteristic of the concavity may also affect the likelihood of lingual perforation (Table 3). The greater the concavity angle, the less likely the probability of lingual perforation (62.4 vs. 55.3, $P < 0.001$). However, for depth that is expected to cause lingual perforation (7.0 vs. 5.0), the larger value tended to have a greater incidence rate (all $P < 0.001$, Table 3). This demonstrated that local anatomical patterns and characteristics have a significant impact to the occurrence of lingual perforation.

Despite the results from numerous studies indicated that the rate of success for immediate
<table>
<thead>
<tr>
<th>Author (era)</th>
<th>Number of participants</th>
<th>Age</th>
<th>Teeth number analysis</th>
<th>Teeth position being analyzed</th>
<th>CPU distribution ratio</th>
<th>Concavity height</th>
<th>Concavity angle</th>
<th>Concavity depth</th>
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<tbody>
<tr>
<td>Chan et al. (2011)</td>
<td>103 (M:35; F:68)</td>
<td>M:51; F:53.2</td>
<td>103</td>
<td>First molar (edentulous ridge)</td>
<td>C (13.6%) P (20.4%) U (66.9%)</td>
<td>12.4 ± 2.7</td>
<td>57.7 ± 10.6</td>
<td>2.4 ± 1.1</td>
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<td>Ou et al. (2012)</td>
<td>60 (M:30; F:30)</td>
<td>43.92 ± 12.33</td>
<td>60</td>
<td>First molar (edentulous ridge)</td>
<td>C (27.0%) P (23.0%) U (50.0%)</td>
<td>15.64 ± 2.9</td>
<td>67.85 ± 8.11</td>
<td>2.18 ± 1.33</td>
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<td>Lin et al. (2013)</td>
<td>57 (M:39; F:18)</td>
<td>45.5 ± 17.0</td>
<td>217</td>
<td>Second premolar, first and second molars (no missing teeth)</td>
<td>C (22.1%) P (21.7%) U (56.2%)</td>
<td>10.6 ± 2.9</td>
<td>61.4 ± 8.1</td>
<td>5.9 ± 2.2</td>
</tr>
<tr>
<td>Huang et al. (2015)</td>
<td>196 (M:102; F:94)</td>
<td>46.0 ± 14.1</td>
<td>833</td>
<td>Second premolar, first and second molars (no missing teeth)</td>
<td>C (20.6%) P (34.7%) U (44.7%)</td>
<td>9.8 ± 3.4</td>
<td>60.8 ± 9.4</td>
<td>5.5 ± 1.9</td>
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Table 4. Retrospective comparison of different studies on mandibular lingual concavity anatomical patterns
implants is not low\(^{38}\); a detailed pre-surgery examination, appropriate diagnosis, rigorous assessment of patients’ various conditions, and have the surgery performed by a doctor with experienced clinical techniques can effectively reduce the risks of implant failure\(^{38,39}\). In terms of scan image diagnostics, intraoral periapical radiographs and panoramic photography are most commonly used as the radiological diagnostic methods\(^{40,41}\). At present, intraoral periapical radiographs and panoramic photography are still considered as a safe, fast, simple, low-cost, and low radiation dose preoperative diagnostic tool in terms of posterior mandibular two dimensional imaging diagnosis for preoperative implant treatment plans\(^{40-43}\). However, three-dimensional CT scans can obtain transverse section images, which contain critical relationship data between anatomical structure and relevant positions as well as more accurate information\(^{40,41}\). The consensus report published by International Congress of Oral Implantologists (ICOI) recommends that cone beam CT scans should be able to provide key data under the following conditions: (1) flapless surgery and computer-assisted implant treatment plan; (2) bone volume of the implantation area has poor quality or is adjacent to important anatomical structure regions; (3) more advanced surgeries are required, such as guided bone regeneration surgeries; (4) suspected developmental defects, trauma, facial lesions, etc.; and (5) assess the post-implantation related complications\(^{40,41}\). Therefore, clinicians should arrange appropriate examinations based on the actual condition of the patient in order to reduce the number of surgeries required and the risks of implantation failure.

**Acknowledgements**

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**References**


立即植牙是將植體置放入新鮮的拔牙窩洞中，已被證實是一可行的治療策略。然而，
就技術上而言，這樣的術式在臨床上是極具有挑戰性，並且被視為是一個「技術敏感」
的手術。因此，臨床醫生在施行這樣的術式時，應該隨時保持注意造成治療失敗的風險與併
發症的可能。如：在下顎後牙區進行立即植牙，不慎穿出舌側皮質骨板導致舌側穿孔，可
能破壞重要的解剖結構，造成神經或血腫損傷等等。當舌側骨板穿孔（LPP）發生在下
顎後牙區，它可能會導致進一步的炎症反應與後續的感染，最終對立即植入的植體產生不
利影響，嚴重者甚至可能導致危及生命的狀況。本研究目的在評估下顎骨後牙區之解剖型
態，量測下顎舌側凹陷的相關解剖參數，並經由模擬植體的置放評估舌側骨板穿孔的可能
發生率。本研究符合參與資格之受試者共有 200 位病人，856 顆牙齒之電腦斷層影像進行
下顎骨形狀（C，P，U 型）之分析，並量測下顎舌側凹陷的相關解剖參數（角度、高度、深
度），透過模擬植體置放預期可能發生舌側穿孔之機率為 14.5%，其中又以下顎第二大臼齒
38.3% 之風險最高，且與其它牙齒相較具統計學之差異性 (p < 0.001)。因此，牙齒型式與
下顎骨及舌側凹陷之解剖構造都與下顎後牙區進行立即植牙產生舌側骨板穿孔的風險具相
關聯性。(臺灣牙周醫誌，20(2):91-102, 2015)

關鍵語：立即植牙，舌側穿孔，舌側凹陷。