

Dapeng Lu  
*Editor*

# Atlas of Wisdom Teeth Surgery



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The Springer logo consists of a white chess knight piece on a pedestal, positioned to the left of the word 'Springer' in a white, serif font.

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Springer

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## Foreword

Wisdom teeth is called the “third molars” according to the dental terminology. Because the third molars are the last to erupt during the human body development stage when the human being reaches the age for intellectual maturity (average 17~21 year-old), they are known as the “wisdom teeth”.

Wisdom teeth are often difficult to erupt into normal position because of the small spaces available in anatomy. Impacted third molars (especially the mandibular third molar) often brought serious damages to human health. For example, wisdom teeth impactions can often cause repeated episodes of pericoronitis, which can lead to special infection and marginal osteomyelitis of the mandible. Wisdom teeth impactions are also often related to the occurrence of second molar distal caries and periodontal disease. Eruption pressure from the wisdom teeth can also lead to development of malocclusion and occlusal trauma, which can also cause periodontal disease or chronic temporomandibular joint trauma. Low position of intraosseous mandibular third molar impaction may also induce facial neuralgia. The mandibular third molar extractions, especially for the low site impactions, are one of the most difficult and challenging operations in the field of oral and maxillofacial surgery. The risk and occurrence for postoperative symptoms and complications including postoperative edema, infection, dry socket and lower alveolar nerve damage are also high. Therefore, the diagnosis and treatment of third molars are the most important aspects in modern day specialty of oral and maxillofacial surgery. With the rapid development of modern science and technology, new ideas, technologies and equipment are continuously emerging to make improvements for third molar related conditions and treatments to become more preventive, predictive, individualized, painless and minimally invasive, etc. The publication of “Atlas of Wisdom Teeth Surgery”, edited by Professor Da-peng LU and his team of highly trained and reputable oral surgeons, is a clear illustration of these technological improvements. Professor LU and the contributors have been dedicated in the teaching and research of oral surgery for a long time with the in-depth studies and knowledge for the third molars. I gained a personal insight of the comprehensiveness of this book after reading it thoroughly from the discussion of basic theories to the clinical diagnosis and treatment modalities.

Undoubtedly, the publication of this book shows excellent in both figure and language that will promote the development and modernization of dental and alveolar surgery.

In view of the above, I am delighted to write a foreword and would like to recommend it to all domestic and foreign colleagues.

Wei-liu Qiu  
Academician of Chinese Academy of Engineering  
Shanghai Jiao Tong University  
Shanghai, China

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## Preface



The publication of WISDOM TEETH SURGERY in 2012 met many of the goals we had set for. However, many suggestions, comments and kind advice were provided by readers, dentists and dental students who desire a more direct guidebook with cases of surgical illustrations to follow in their clinical practice and learning. As a result, ATLAS OF WISDOM TEETH SURGERY has been accomplished, aiming to present the fundamental principles of surgical treatments with illustrations on third molar problems.

This atlas as a guidebook with twenty chapters will cover the latest surgical techniques and clinical cases with a procedure-based approach which will address the following topics focusing on the impact of third molars: factors of wisdom teeth and their

mechanism; resistance classification of wisdom teeth growing status; X-Rays, clinical technologies and surgical methods for impacted wisdom teeth extraction; preparation of operation, therapeutic extraction of impacted wisdom teeth for adolescents; prevention, avoidance and management of complications during and after surgery. Each chapter consists of two to six sections with case study in some of the chapters to provide suitable details on the clinical illustrations and the fundamental techniques of evaluation, diagnosis, surgical design and surgical procedures, which makes immediate clinical application possible. The pictures illustrated in the chapters were all taken during real time operations to make the surgical techniques easily understandable.

What is new in this atlas is the classification method on wisdom teeth and the difficulty level determination for the treatment. Impacted wisdom teeth are divided into five major categories in three-dimensions that are detected by CBCT. Based on the position and growth status of the impacted teeth, six classification levels of difficulty can be determined for the planning of surgery time and surgical steps that are needed for each level. Nitrous oxide sedation method is also added in this atlas.

Over these many years, we have taken about 1800 clinical photographs and line drawings with case reports of clinical illustrations of third molar problems. These illustrations offer detailed, practical based instructions and demonstrate recent treatment procedures in logical sequence of how to plan and perform wisdom teeth surgeries safely and efficiently. These illustrations and demonstrations were made for dentists and specialty students to grasp the surgical details easily. It is our sincere hope that the readers will find the illustrations and case study readily understandable, yet instructive and useful. This book will also be used as a foundation for residency training.

Beijing, China

Dapeng Lu

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## Acknowledgments

First of all, we appreciate all the help and support that made valuable contribution to this book: the patients who contributed with the first-hand materials for case studies; the dentists who provided us valuable suggestions with details on the Atlas of Wisdom Teeth Surgery in Chinese version, which is the foundation of much improvements made for the English version of this book; our students for the collection of needed materials; the publishing team for the design of the book's cover, the art works and all the efforts they have put into this book.

We are deeply grateful to the following experts for their support and expertise. We wish to express profound gratitude and special thanks to Prof. Weiliu Qiu, Academician of Chinese Academy of Engineering, Chair professor in Shanghai Jiao Tong University, for his encouragement, valuable suggestions and his efforts in writing the foreword for this book. We also would like to express our sincere appreciation to Prof. Xing Wang, Peking University Hospital of Stomatology, former Chairman of Chinese Stomatology Association, for his passionate support in the preparation of this book. Our sincere gratitude must also go to Prof. Tokio Osaki, Kochi University Medical School, Japan, for his constant support and technical guidance. It has been our great pleasure and honor to work with the above specialists on this book. Much thanks also go to Dr. Shelly Xiao-Yue Yu, Lakeview Dental Office, Chicago, CA, who helped us proof read the text, and Prof. Rudong XING for his valuable suggestions in Beijing Stomatological Hospital, Capital Medical University, China.

We would like to acknowledge those who dedicated to the Atlas of Wisdom Teeth Surgery, especially the contributors to each chapter who have contributed their valuable time, efforts, patience and expertise to give simple-to-follow illustrations and explanations for the surgical procedures. We also wish to thank all the patients who signed agreements that provided their permissions for us to use their clinical data and photos for research and academic study.

Our gratitude is also extended to the individuals at our hospital and professional colleagues who worked closely with us to help us accomplish this book. Finally, this book would not have been possible without the understanding, the constant support and the encouragements from our families.

Dapeng Lu

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## Editor Introduction

*Dapeng Lu*, after receiving the bachelor's degree in oral medicine in 1982, became a dentist in the oral surgery department in a university hospital, which provided him more opportunities to treat the student patients.

During his 10 years of research and study in the specialty of oral and maxillofacial surgery in Kochi Medical School Japan, Dr. Lu gained tremendous amount of research experiences which became a solid academic foundation for his clinical teaching and research career as a dentist and professor in Beijing Stomatological Hospital, Capital Medical University, China. His present research is focused on dental and alveolar surgery and oral pathology biology, and he is an expert in teaching oral and maxillofacial surgery, oral anatomy and physiology. Each year, his team holds public lecture tours on dental and alveolar surgery in Beijing and many other cities in China, which have helped many dentists and oral surgery specialty students to improve their surgery skills.

Recent Publications:

1. Wisdom Teeth Surgery, People's Medical Publishing House, China, 2012, Editor in chief.
2. Oral Tumor Biology: The Basic and Clinical. People's Medical Publishing House, China, 2014, Editor in chief. (government fund support NFAPST).
3. Atlas of Wisdom Teeth Surgery, People's Medical Publishing House, China, 2016, Editor in chief.
4. Dental and Alveolar Surgery, People's Medical Publishing House, China, 2016, contributor.
5. Brief Textbook on Lesions of the Salivary Glands and Hyposalivation-Associating Fungal Infections, Asuka Press Company, Japan, 2009, contributor.

# Normally Erupted and Impacted Wisdom Teeth

Dapeng Lu and Yi Fan



Wisdom teeth are the third molars. Normally erupted wisdom teeth occlude properly with their corresponding opposing teeth in the upper or lower dental arch. They are located within the same dental arch curve as the second molars, and the crowns are not covered by any gingival tissue. In clinical situations, normally erupted wisdom teeth are rare, while impacted wisdom teeth are common. Malpositioned wisdom teeth could be defined as impacted wisdom teeth.

## 1.1 Section 1: Normal Position of Wisdom Teeth

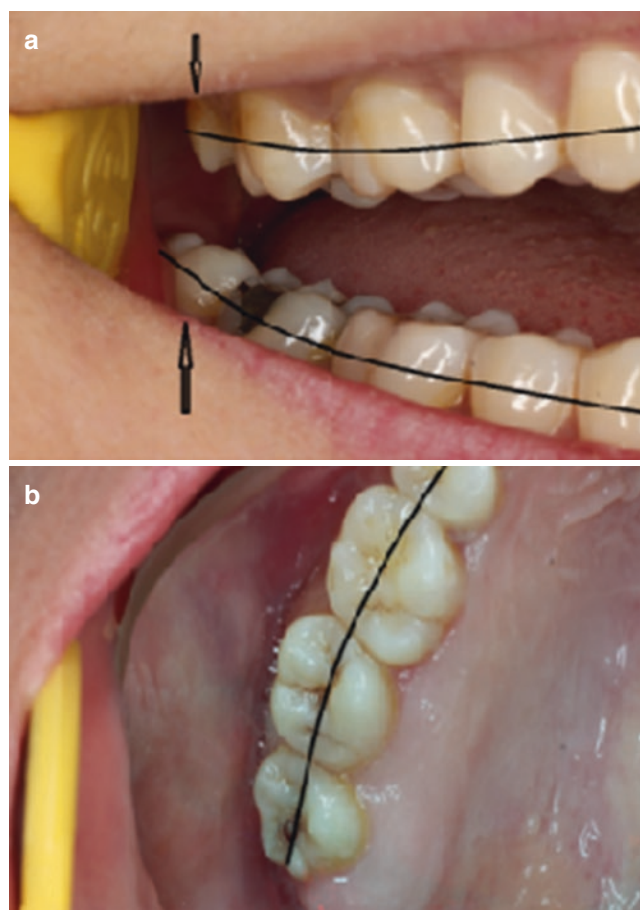
Initiated from tooth germs, wisdom teeth gradually grow and migrate toward the alveolar ridge, where they erupt into the normal position. The following six criteria define a normal position of a wisdom tooth.

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Y. Fan  
Melbourne Dental School, University of Melbourne,  
Melbourne, VIC, Australia

### 1.1.1 Wisdom Tooth Locates Within the Dental Arch Curve

The long axis of the wisdom tooth should be perpendicular to and locate within the dental arch curves (Fig. 1.1).



**Fig. 1.1** (a) The maxillary and mandibular wisdom teeth locate within the extended dental arch curves. (b) The maxillary wisdom tooth is located within the dental arch curve. (c) The mandibular wisdom tooth locates within the dental arch curve

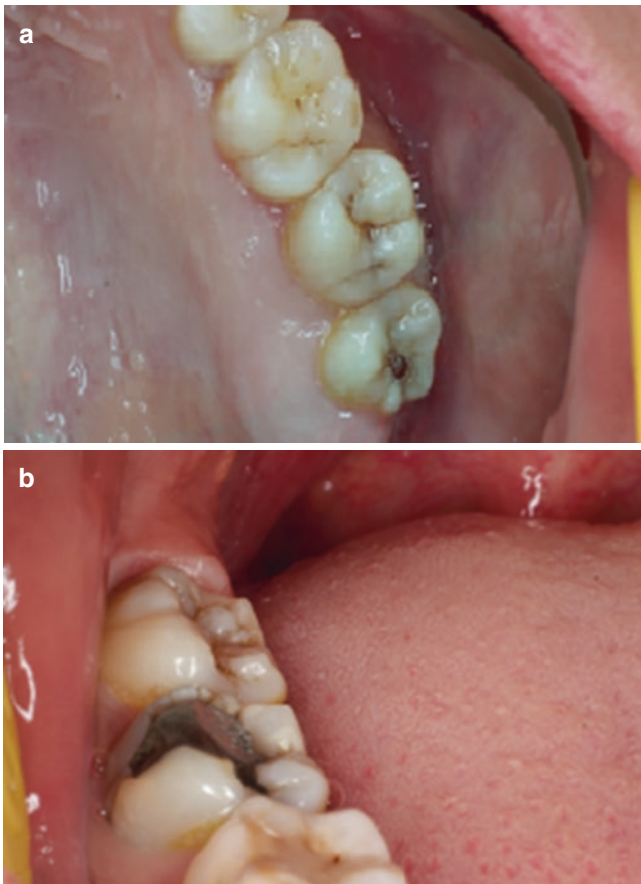




**Fig. 1.1** (continued)

### 1.1.2 The Occlusal Plane of a Wisdom Tooth Is Consistent with that of the Other Molar

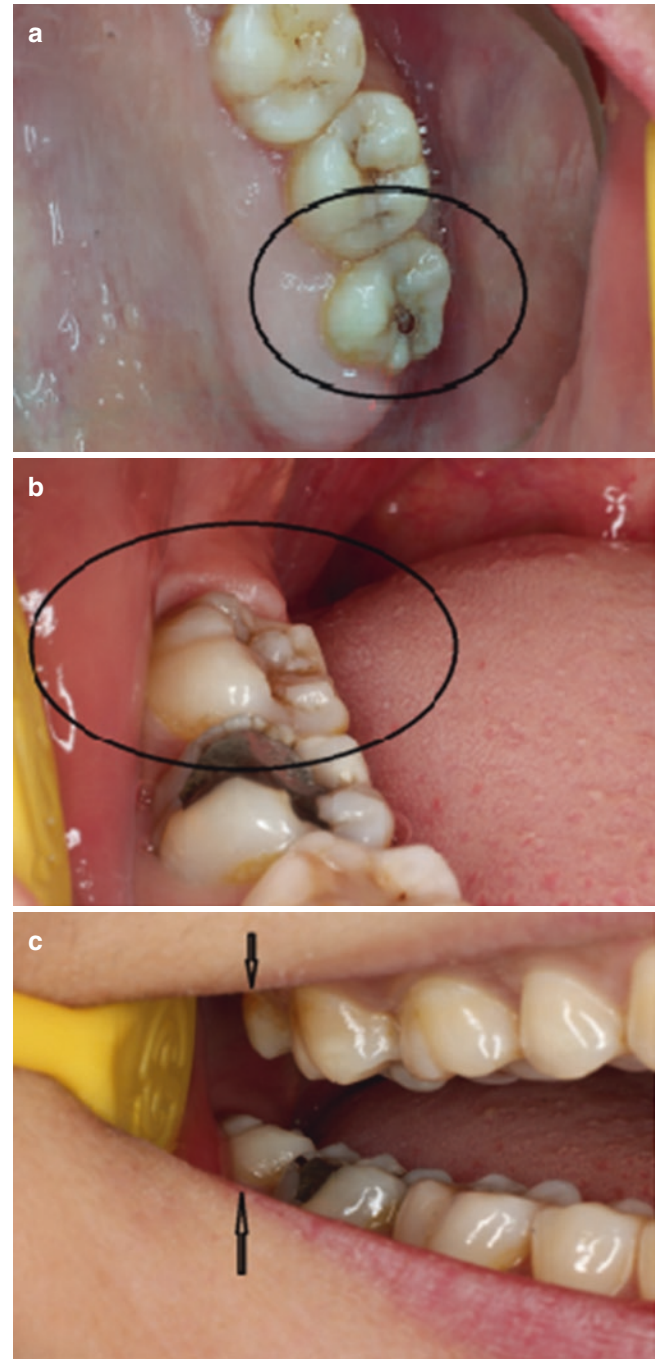
The occlusal plane is not above nor lower than that of the second molar (Fig. 1.2).



**Fig. 1.2** (a) The occlusal plane of the maxillary wisdom tooth is at the similar level with that of the upper molars. (b) The occlusal plane of the mandibular wisdom tooth is at the similar level with that of the lower molars

### 1.1.3 Wisdom Tooth Not Malpositioned nor Tilted

Wisdom tooth is neither tilted toward the buccal, nor the lingual (palatal), nor the mesiodistal side (Fig. 1.3).

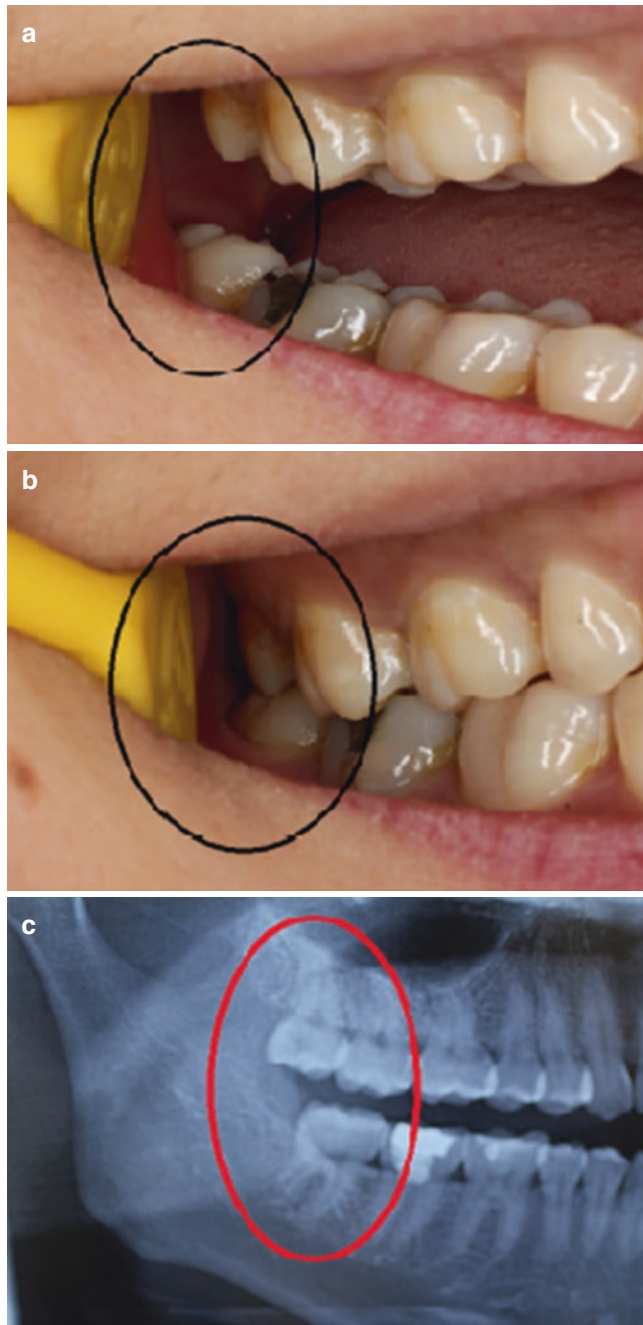


**Fig. 1.3** (a) The normal position of a maxillary wisdom tooth is neither tilted toward the buccal nor the palatal side. The mesial height of contour of the wisdom tooth contacts closely with the distal height of contour of the second molar. (b) The normal position of a mandibular wisdom tooth is neither tilted toward the buccal nor the lingual side. The mesial height of contour of the wisdom tooth contacts closely to the distal height of contour of the second molar. (c) A normally positioned wisdom tooth tilts neither toward the buccal/lingual nor the palatal side of the dental arch



### 1.1.4 Normal Occlusal Relationship of the Upper and Lower Wisdom Teeth

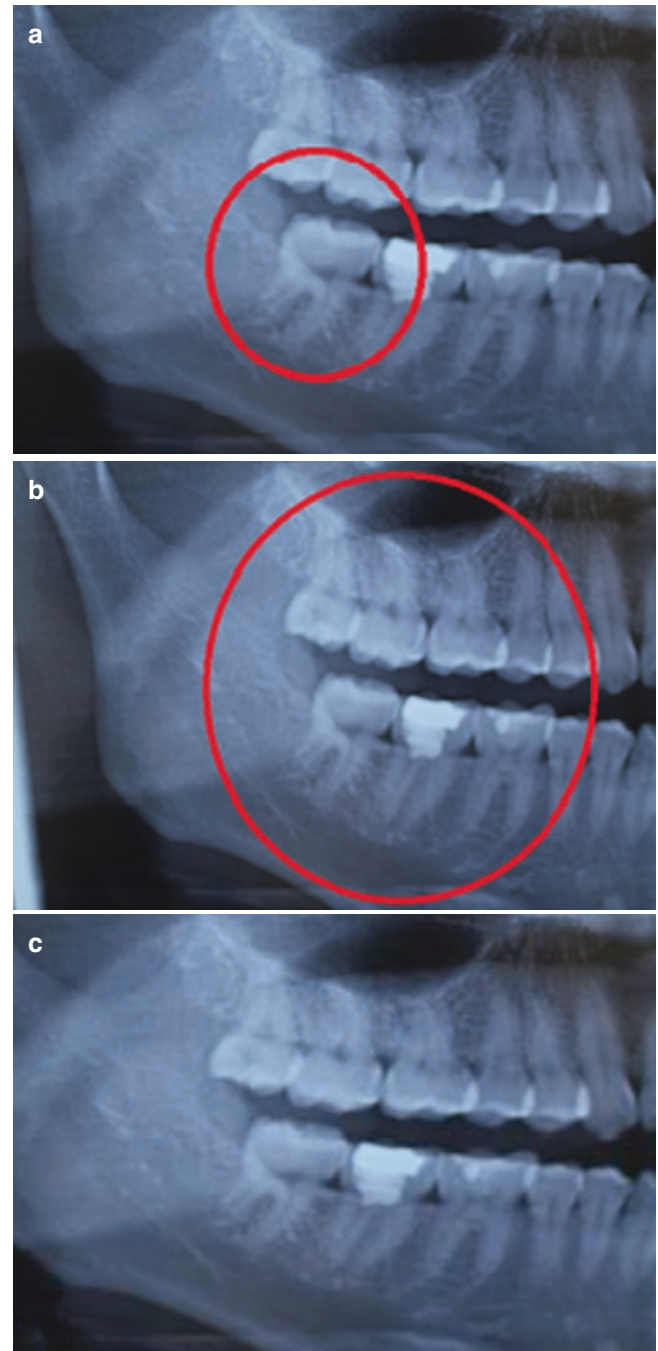
When the normally positioned upper wisdom tooth occludes with the normally positioned lower wisdom tooth on the same side, the buccal cusp of the upper wisdom tooth occludes in the buccal groove of the lower wisdom tooth, and the palatal cusp of upper wisdom tooth occludes in the central groove of the lower wisdom tooth, which form the normal occlusion (Fig. 1.4).



**Fig. 1.4** (a) The upper and lower wisdom teeth on the same side are corresponding even in an openmouthed position. (b) The upper and lower wisdom teeth form the normal occlusal relationship. (c) The upper and lower dentition in the state of rest jaw position shown in a panoramic radiography

### 1.1.5 Normal Dental Alveolar Septum Between Wisdom Tooth and Second Molar

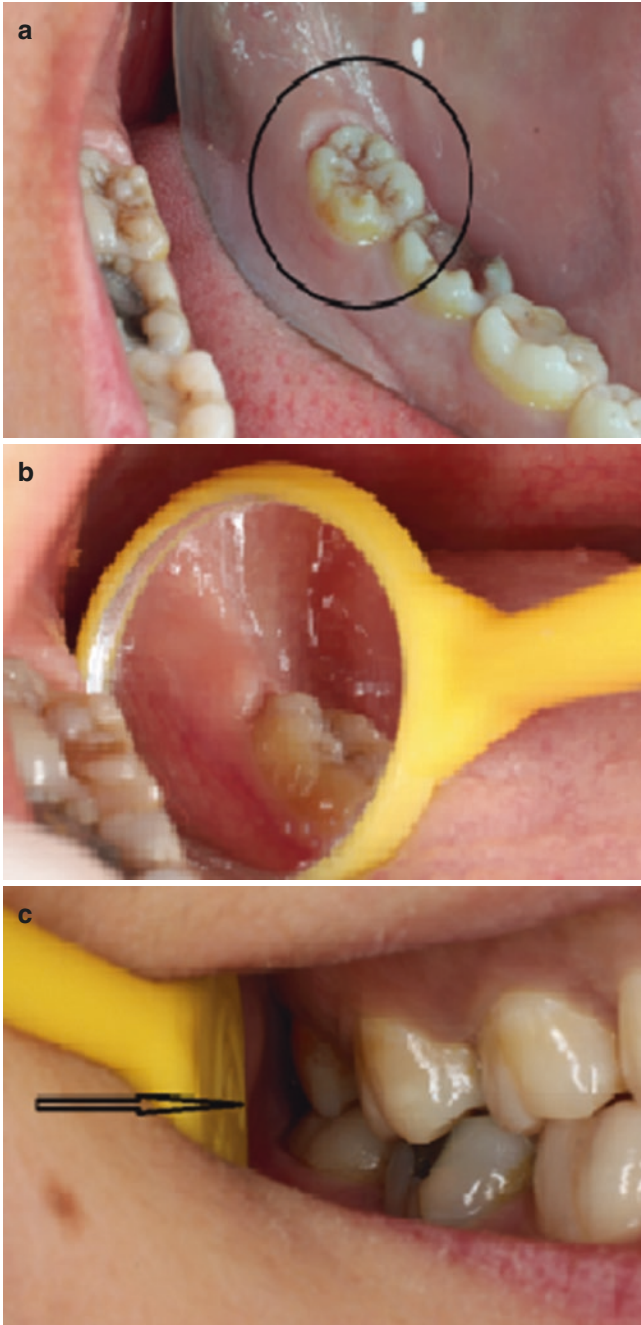
Teeth grow within the dental alveolar bone, and normally, complete alveolar septum exists between the teeth (Fig. 1.5).



**Fig. 1.5** (a) The dental alveolar bone septum and alveolar ridge between the mesial root of a normally positioned mandibular wisdom tooth and the distal root of the second molar is indicated in the red circle. (b) The dental alveolar bone septum and alveolar ridge between the mesial root of a normally positioned upper and lower wisdom teeth and the distal root of the second molars on the same side is indicated in the red circle. (c) It is necessary to evaluate the surrounding structures of the wisdom tooth and the opposing teeth when judging clinically whether it is in a normal position or not. It is also important to evaluate the intra-oral X-ray films or, even better, the panoramic radiography

### 1.1.6 Gingival Margin Is Attached to the Neck of Wisdom Tooth

The gingival margin is attached to the neck of the tooth, and so the wisdom tooth, including the mesiodistal and the buccal gingival margin of the crown (Fig. 1.6).



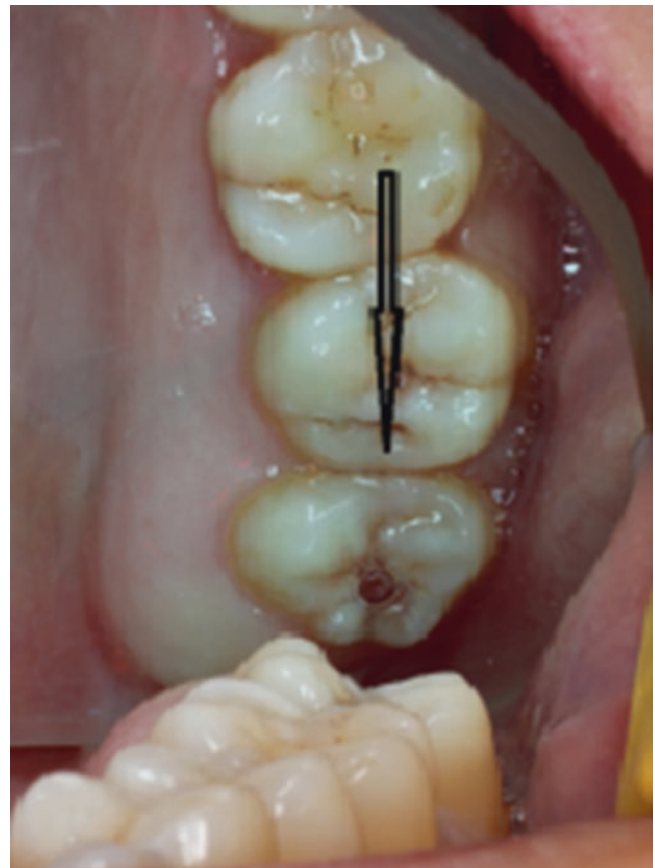
**Fig. 1.6** (a) The mesial, distal and the buccal gingival margin of the crown is attached to the neck of the wisdom tooth (the black circle indicates the normally positioned mandibular wisdom tooth). (b) The lingual gingival margin is attached to the neck of the wisdom tooth. (c) The attachment of the gingival margin is at the neck of the wisdom teeth when the upper and lower normally positioned wisdom teeth occlude

### 1.1.7 Appendix: Routine Examination List for Wisdom Tooth

Routine examination of wisdom tooth includes clinical examination, panoramic radiograph, and CBCT when necessary (Figs. 1.7, 1.8, 1.9, 1.10, and 1.11).



**Fig. 1.7** Examine the presence of a maxillary wisdom tooth. If yes, examine whether the crown of the tooth is completely exposed, whether the buccal lingual (palatal) gingival margin is attached to the cervical part of the tooth, and whether the mesial dental papilla and the retromolar pad are normal

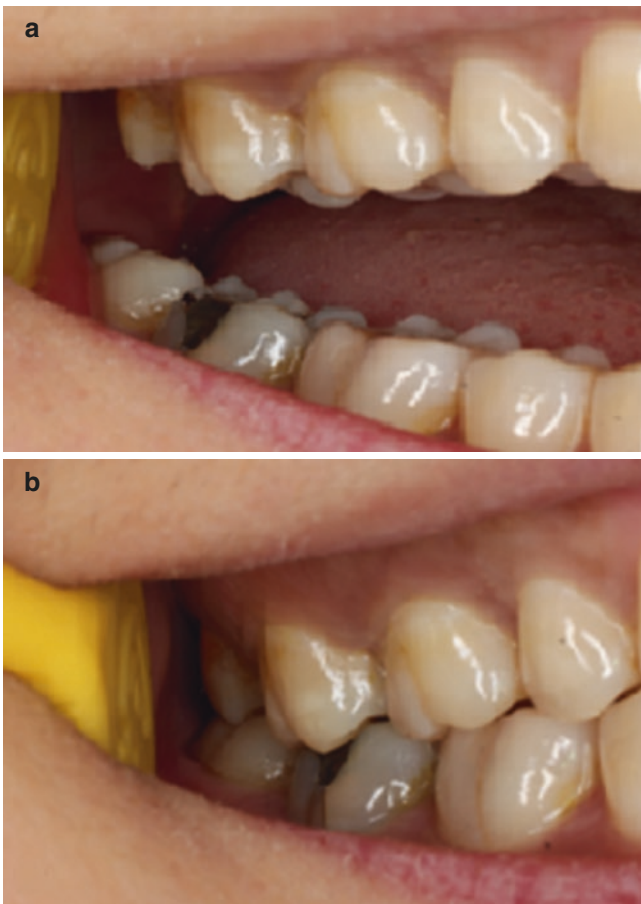


**Fig. 1.8** Examine the position of the maxillary wisdom tooth, e.g., high or low, palatal or buccal positioned

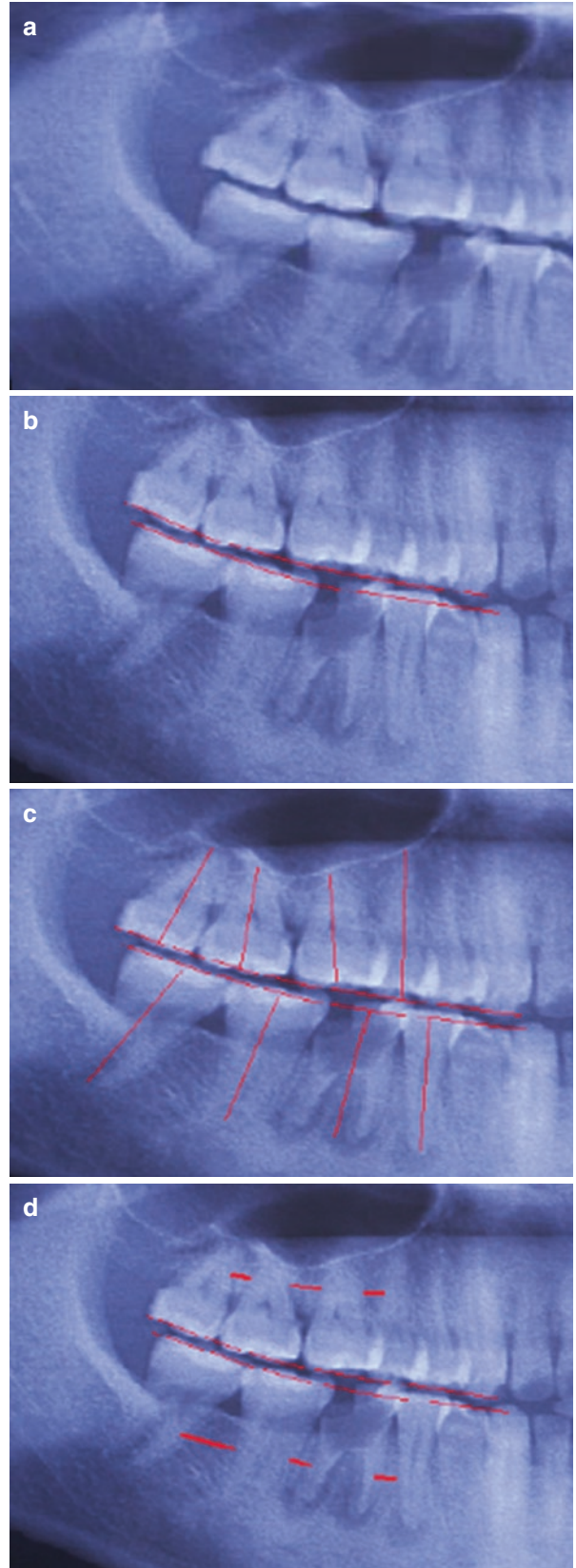




**Fig. 1.9** Examine the relationship between the mandibular wisdom tooth and the surroundings to see whether the wisdom tooth locates within the dental arch curve and whether the occlusal plane is higher or lower than that of the front teeth



**Fig. 1.10** (a) Examine the upper and the lower dentition. Open the mouth with dental mirror; first examine the presence of the maxillary and mandibular wisdom teeth. (b) Examine the occlusal relationship to see whether there is normal overbite between the upper and lower wisdom teeth



**Fig. 1.11** Panoramic radiography examination (X-ray). (a) Occlusal relationship between the upper and lower molars. (b) Dental arch curve during occlusion (red line). (c) Mesiodistal inclination of the dental axis (red line). (d) The roots of the molars are separated from the roots of the adjacent molars (red line)

## 1.2 Section 2: Concepts of Impacted Wisdom Teeth

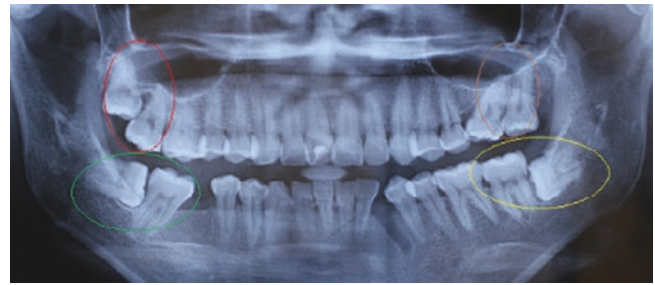
Due to human evolution and changes in the food chain as well as the degeneration of the jaw, the available space for the last molars in the jaw became insufficient, which results in inhibiting or preventing factor for the migration and eruption of the wisdom tooth. Therefore, the wisdom tooth becomes impacted when its growth stays in a certain state.

### 1.2.1 Mesial

Human teeth are located in the dental alveolar bone with the interalveolar septum in between the roots of the adjacent teeth. The interalveolar septum displays a triangular shape between the normally positioned wisdom tooth and the second molar. In the description of the impacting status of the wisdom tooth, if the interalveolar septum undergoes damage to various degrees, it is mostly due to the alveolar bone resorption, which is caused by the forward displacement of the wisdom tooth. Therefore, this impacting status of wisdom tooth is called mesial impaction (Figs. 1.12 and 1.13).



**Fig. 1.12** The mesial crown, neck, and root of the wisdom tooth firmly contact with the distal crown, neck, and root of the second molar. The interalveolar septum between the wisdom tooth and the second molar partially or completely disappeared



**Fig. 1.13** #18 wisdom tooth, mesioangular impacted wisdom tooth at middle-level position; #28 wisdom tooth, mesially and vertically impacted wisdom tooth at middle-level position; #38 wisdom tooth, mesially and horizontally impacted wisdom tooth at low-level position; #48 wisdom tooth, mesially and horizontally impacted wisdom tooth at middle-level position

### 1.2.2 Spacing and Distal

According to the distance between the mesial crown, neck, and root of the wisdom tooth and the distal crown, neck, and root of the second molar, the impacting status could be divided into spacing and distal impaction. Spacing impaction indicates that there is increased distance from the mesial crown edge of wisdom tooth to the distal root of the second molar. In addition to the increased distance, distal impaction is also involved with the direction of crown inclination (Figs. 1.14, 1.15, and 1.16).

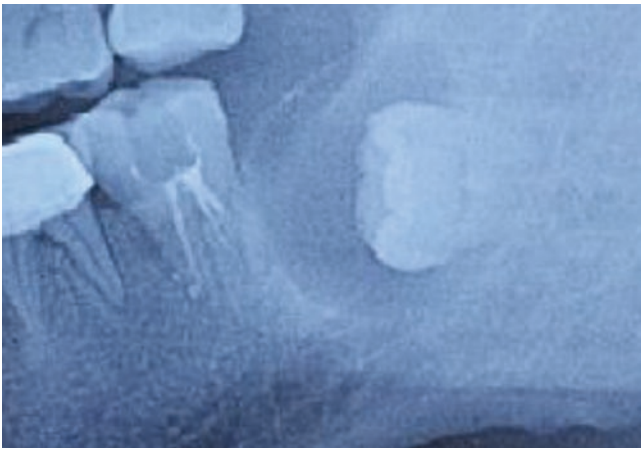


**Fig. 1.14** Spacing impaction. There is about one root distance from the mesial crown edge of the wisdom tooth to the distal root of the second molar





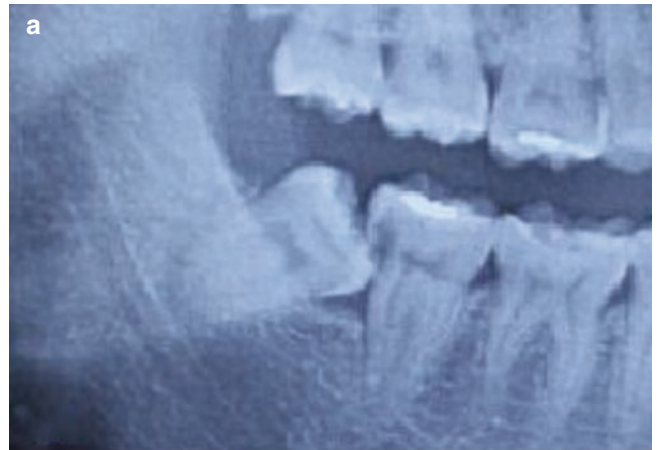
**Fig. 1.15** Spacing impaction at middle level in the right mandible



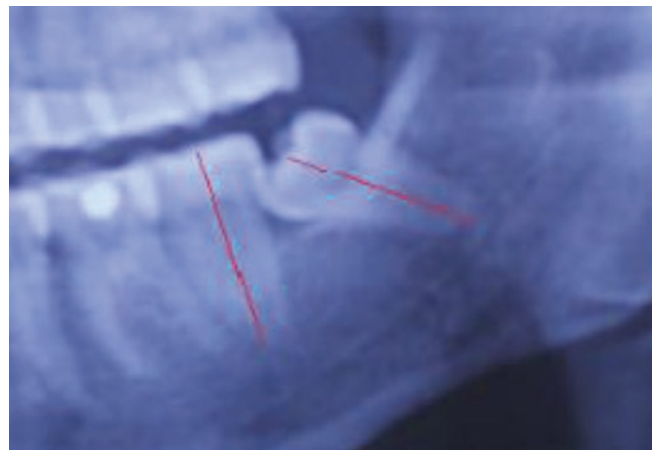
**Fig. 1.16** The distance from the mesial crown edge of the wisdom tooth to the distal root of the second molar is about as wide as two roots or one tooth, which is called distal

### 1.2.3 Inclination

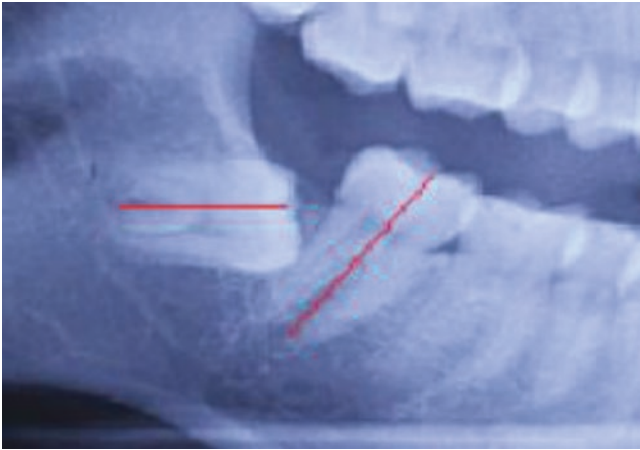
Inclination is an impaction state of a wisdom tooth. Draw a line on the long axis of second molar as a reference, and then draw a line from mesial to the distal of the occlusal plane, and a vertical line from the center of crown to the root tip, which is the long axis. If the angle formed by the long axis of the wisdom tooth and the second molar is less than  $90^\circ$ , it is in inclination status (Figs. 1.17, 1.18, 1.19, 1.20, and 1.21).



**Fig. 1.17** (a, b) Mesioangular wisdom tooth. If the angle formed by the long axis of the wisdom tooth and the second molar is less than  $90^\circ$ , it is inclined



**Fig. 1.18** The impacting location of the wisdom tooth is mesial and embedded



**Fig. 1.19** The mesial crown edge of the wisdom tooth contacts firmly with the distal root of the second molar



**Fig. 1.20** The mesioangular crown of the maxillary wisdom tooth squeezes on the distal neck of the second molar, which resulted in the alveolar ridge in between the two teeth absorbed



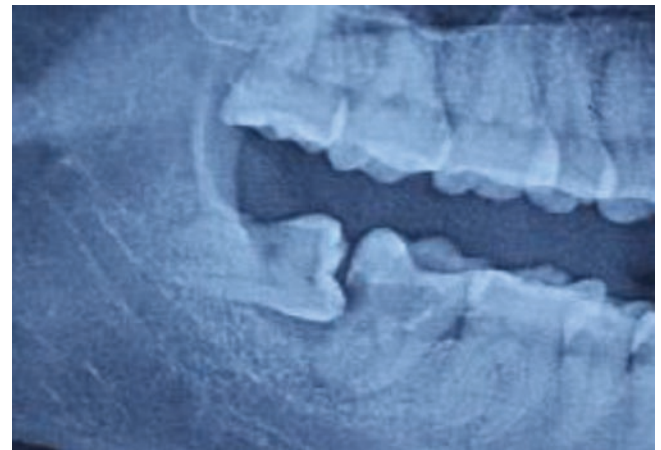
**Fig. 1.21** The mesiodistal crown of the wisdom tooth embedded in the mandible, and the root of the wisdom tooth entered the inferior alveolar nerve canal

## 1.2.4 Embedded

Embedding refers to the depth of the crown of the wisdom tooth that is embedded in the distal crown, neck, or root of the second molar, which can be expressed as  $1/2$ ,  $1/3$ , or  $1/4$  of the diameter of the embedded horizontal molar (indicates the degree of second molar injury) (Figs. 1.22, 1.23, 1.24, 1.25, and 1.26).

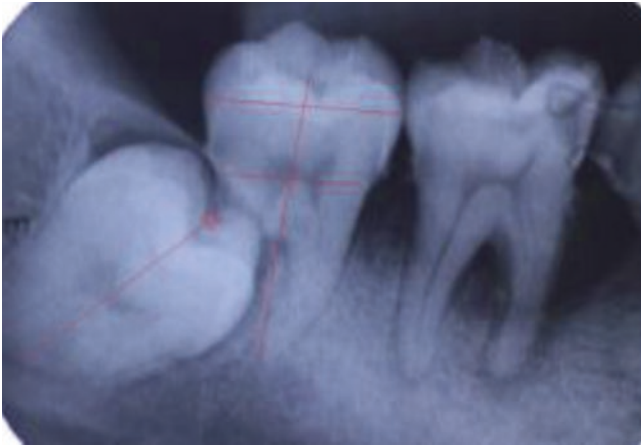


**Fig. 1.22** The crown of the wisdom tooth embedded into the distal crown of the second molar

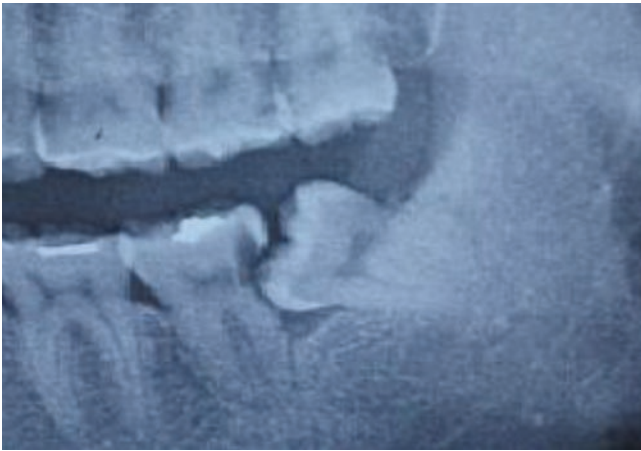


**Fig. 1.23** The mesial crown edge of the wisdom tooth embedded into the neck of the second molar (the depth is about  $1/4$  diameter). The wisdom tooth displays a horizontal impacting status

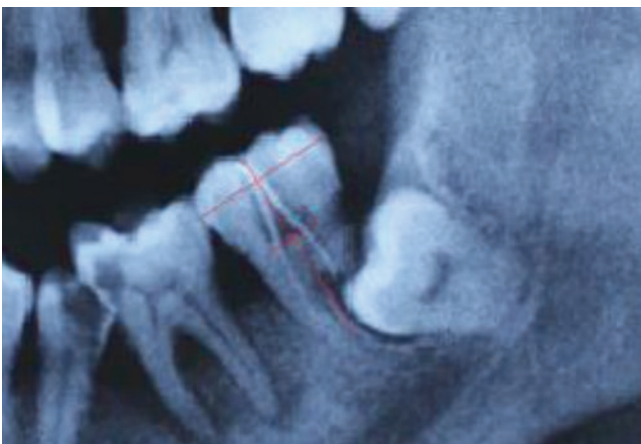




**Fig. 1.24** The second molar is divided into three parts: the crown, neck, and root. Most of the crown of the wisdom tooth embedded into the root of the second molar. The distal root of the second molar is already absorbed completely and disappeared (1/2)



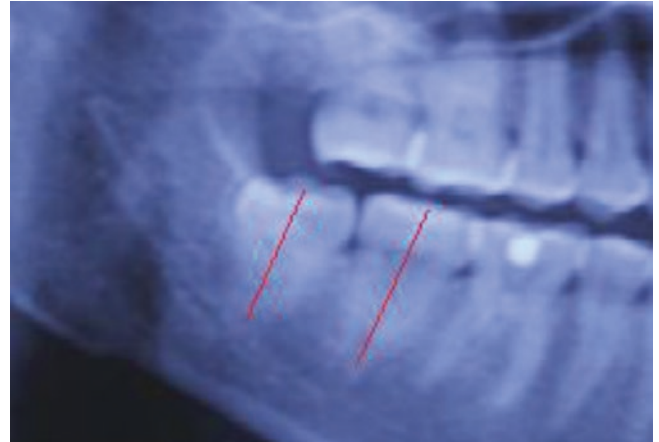
**Fig. 1.25** Mesioangular impaction of the wisdom tooth that is embedded into the neck of the second molar (1/2)



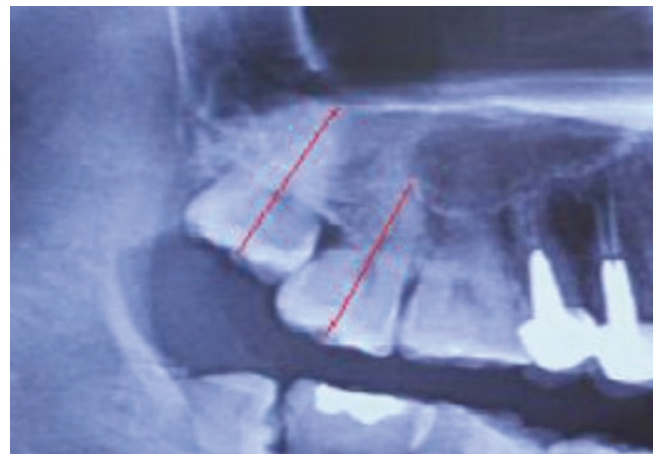
**Fig. 1.26** The mesioangular impaction of the wisdom tooth embedded into the root (1/2) of the second molar and its root enters completely into the inferior alveolar nerve canal

## 1.2.5 Vertical

When the long axis of the crown and root of wisdom tooth is parallel to that of the second molar, it is in the state of vertical impaction (Figs. 1.27, 1.28 and 1.29).



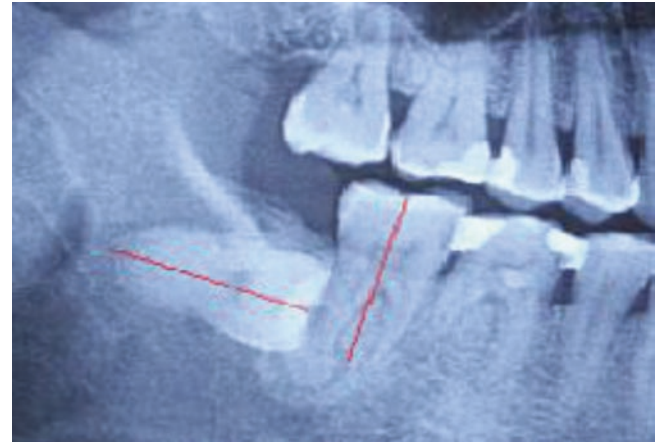
**Fig. 1.27** When using the second molar as a reference, if the long axis of the wisdom tooth is parallel to that of the second molar, it is a vertical impaction. The long axis of a normally positioned wisdom tooth is also parallel to that of the second molar. This tooth has excess bone from the ramus covering the distal crown of the wisdom tooth, and there is no wisdom tooth in the upper jaw



**Fig. 1.28** Although the long axis of the wisdom tooth is parallel to that of the second molar, the occlusal plane of the crown of the wisdom tooth is lower than the distal height of contour of the second molar, and therefore, it is called vertical impaction



**Fig. 1.29** Mandibular wisdom tooth with a normally positioned upper wisdom tooth. The mesial crown of the mandibular wisdom tooth locates underneath the distal height of contour of the crown of the second molar. The distal crown of the wisdom tooth is pushed forward by the mandibular ramus, which makes the wisdom tooth slightly tilting forward



**Fig. 1.31** The long axis of the wisdom tooth locates at the same level with the root of the second molar, and the wisdom tooth embeds completely in the jaw

### 1.2.6 Horizontal

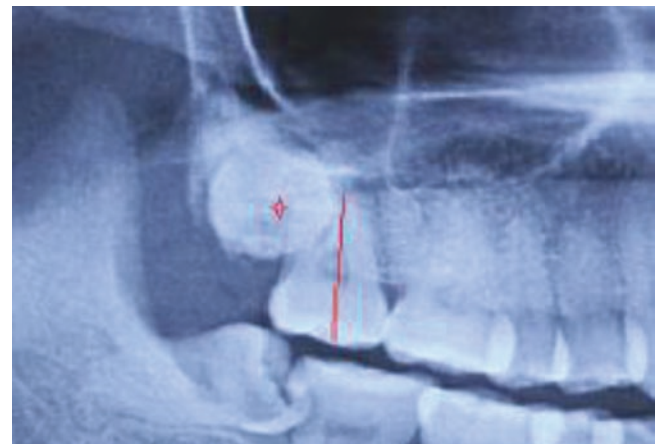
When the long axis of the wisdom tooth is perpendicular to that of the second molar, the wisdom tooth is horizontally impacted. It is more often seen in the situation that the crown of the wisdom tooth is in mesial direction and less in buccal direction (Figs. 1.30, 1.31, 1.32, and 1.33).



**Fig. 1.32** If the crown, neck, and root of the second molar are divided into three parts, high, middle, and low, the impaction status is mesially and horizontally impacted at low-level position



**Fig. 1.30** Take the second molar as a reference: when the angle formed by the long axis of the wisdom tooth and that of the second molar is approximately  $90^\circ$ , it is horizontal impaction



**Fig. 1.33** The crown of the maxillary wisdom tooth faces buccally, and its root faces palatally. The wisdom tooth is in a horizontal position and perpendicular to the root of the second molar



### 1.2.7 Reverse

The occlusal plane of the wisdom tooth faces distal direction. When the angle formed by the long axis of the wisdom tooth and that of the second molar is less than  $90^\circ$ , it is inclined. If the angle equals  $90^\circ$ , it is horizontal (Fig. 1.34).



**Fig. 1.34** A left maxillary wisdom tooth with reversely and distally inclined impaction at high level

### 1.2.8 Underneath (Mandibular Subapical)

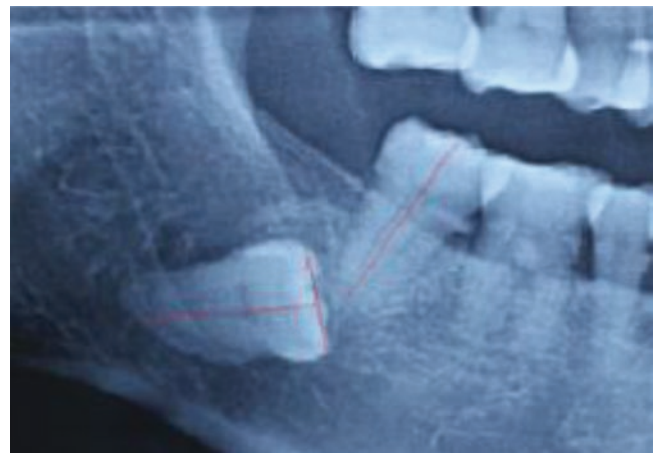
For the mandibular impacted teeth, draw the long axis lines for the wisdom tooth and the second molar. Extending from the intersection of the long axis and occlusal plane of the wisdom tooth toward the long axis of the second molar, if the extended line is underneath the apex of the second molar, such impacting status is a mandibular subapical impaction (Figs. 1.35, 1.36, 1.37, and 1.38).



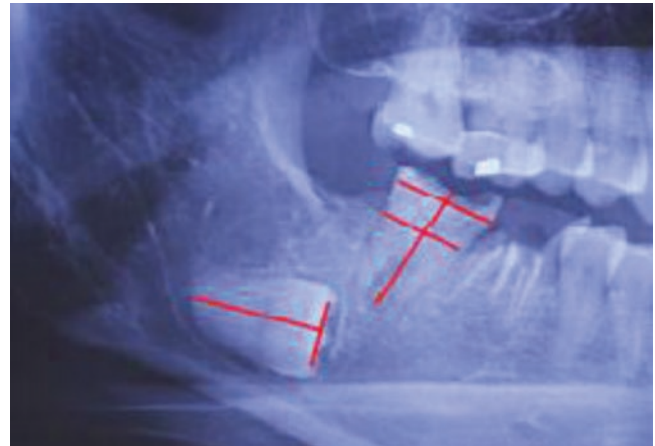
**Fig. 1.35** The wisdom tooth displays horizontal impacting status. The extension of the long axis of the wisdom tooth locates underneath the apex of the second molar



**Fig. 1.36** The crown of the wisdom tooth faces buccally. The long axis of the wisdom tooth is perpendicular to that of the second molar, and the intersection point of the long axis and the occlusal plane of the wisdom tooth is lower than the apex of the second molar



**Fig. 1.37** The wisdom tooth displays inclination status. The intersection point of the long axis and the occlusal plane of the wisdom tooth is underneath the apex of the second molar



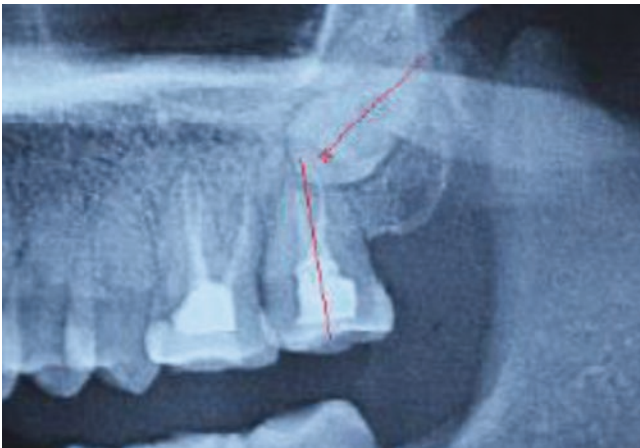
**Fig. 1.38** The red lines can precisely describe the impacting status of the wisdom tooth. The wisdom tooth is mesially inclined and embedded underneath the second molar

### 1.2.9 Upper (Maxillary Subapical)

For the maxillary impacted teeth, if a line is extended from the intersection of the long axis and the occlusal plane of the wisdom tooth toward the long axis of the second molar, and such extension line is above the apical part of the second molar, the state of the wisdom tooth is a maxillary subapical above impaction (Figs. 1.39 and 1.40).



**Fig. 1.39** Maxillary subapically, mesially, buccally, and horizontally impacted wisdom tooth

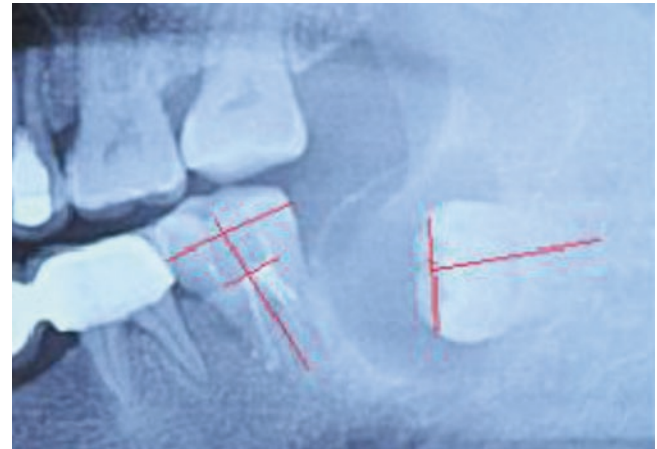


**Fig. 1.40** Embedded (3/4) maxillary subapically impacted wisdom tooth

### 1.2.10 Front and Rear

Take the second molar as a marker: if the impacted wisdom tooth locates underneath the root or in front of the root of the second molar, it defines as front. If the impacted wisdom tooth locates with a distance of mesiodistal diameter of the wisdom

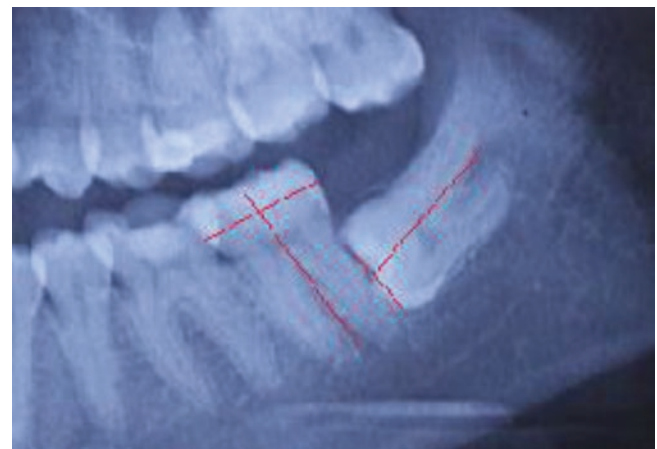
tooth crown to the second molar, it defines as rear. It is applicable to the upper and lower impacted wisdom teeth (Fig. 1.41).



**Fig. 1.41** Distal (rear) and horizontally (or inclined) impacted low wisdom tooth. In this figure, the concept of distal and rear has similar meaning, while horizontal and inclining have similar meaning

### 1.2.11 Inverse

The status that the crown of the wisdom tooth is facing toward the root of the second molar is called inversion of the wisdom tooth. Strictly speaking, inversion can only be defined when the long axis of the second molar and the impacted wisdom teeth is reversely parallel with each other. This is almost nonexistent. Therefore, when the angle formed by the long axis of the wisdom tooth and that of the second molar is more than  $90^\circ$ , it is regarded as an inverted state (Figs. 1.42, 1.43, and 1.44).

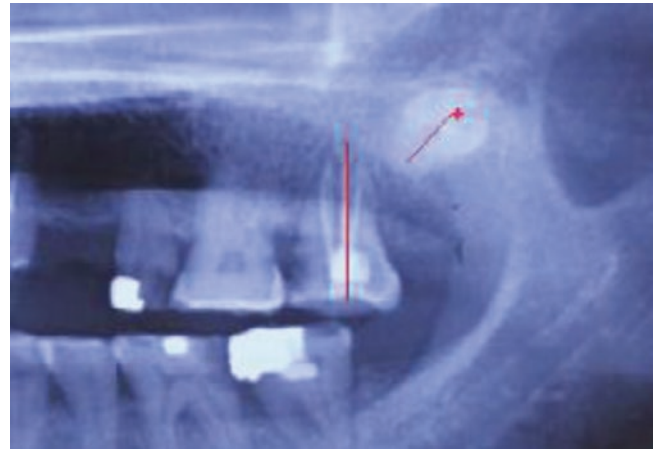


**Fig. 1.42** Mesially and horizontally inverted impacted wisdom tooth. The angle formed by the long axis of the wisdom teeth and that of the second molar is more than  $90^\circ$





**Fig. 1.43** Mesioangular and inverted impacted wisdom tooth. The inverted root of the wisdom tooth is restricted by the mandibular ramus

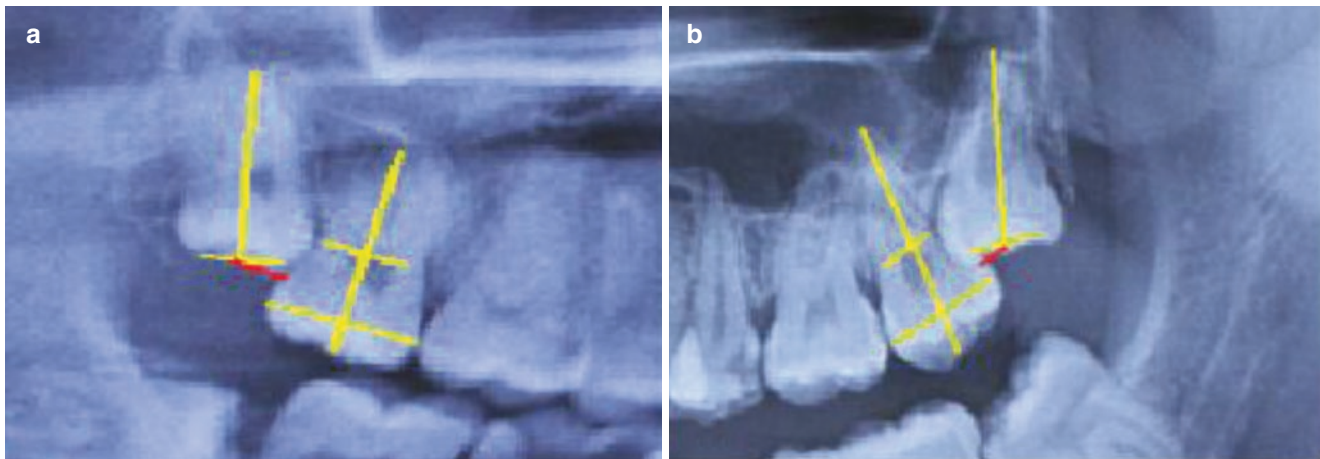


**Fig. 1.44** Distally and inverted impacted high wisdom tooth in the maxilla

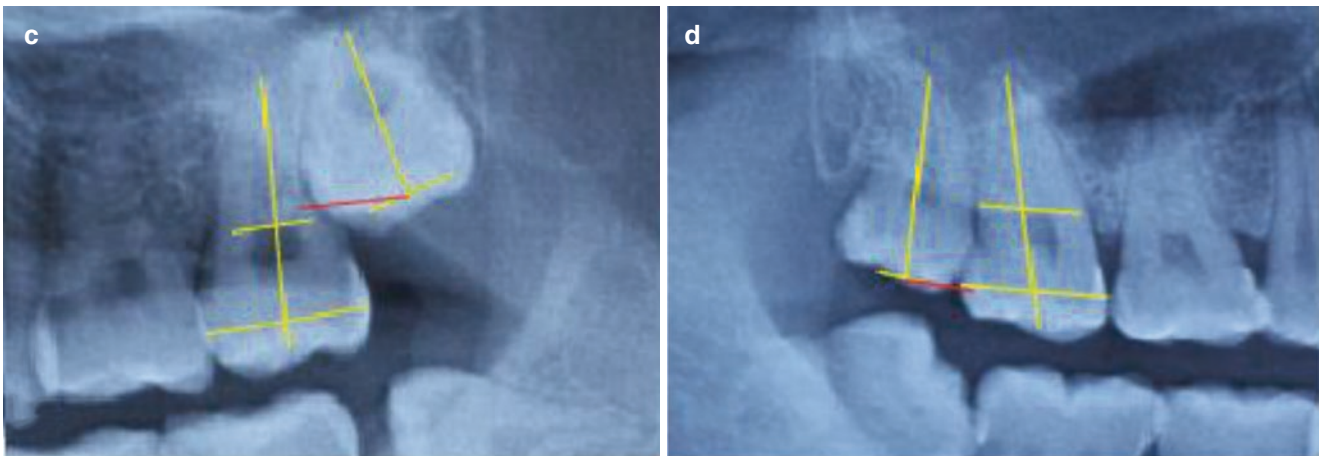
### 1.2.12 High, Middle, and Low Level

Draw two horizontal lines perpendicular to the long axis of the second molar. One horizontal line is drawn between the mesial and distal contact points of the crown, and the other is at the pulpal floor of the second molar. The two horizontal lines divide the second molar into three parts. For mandibular wisdom tooth, high level indicates that the wisdom tooth is located above the height of contour of the crown of the mandibular second molar; middle level indi-

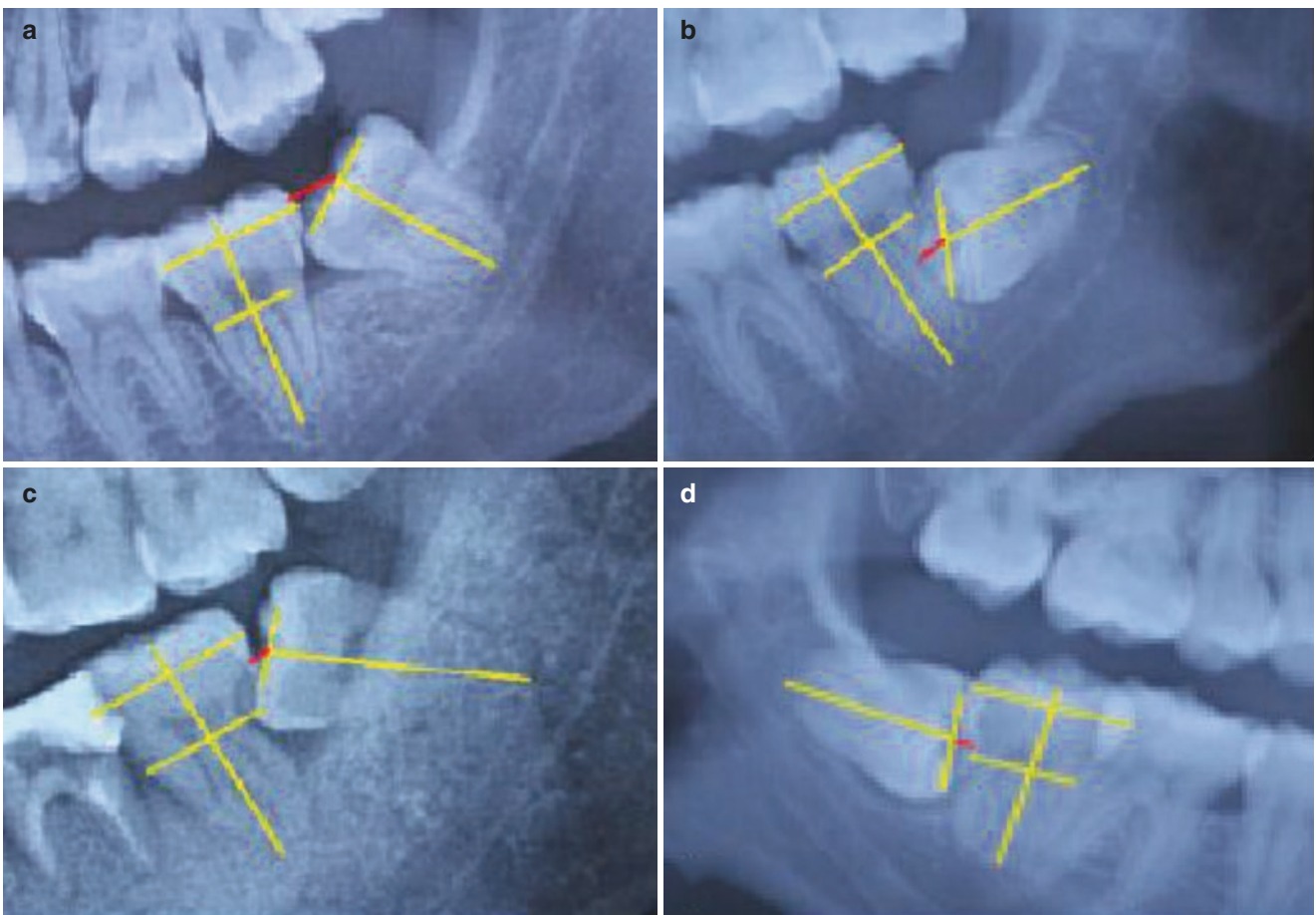
cates the wisdom tooth is located between the height of contour of the crown and the pulp chamber floor of the second molar; and low level indicates that the wisdom tooth is located in between the pulp chamber floor and the apex of the second molar. The levels of impaction for maxillary wisdom tooth are defined in the opposite way. Draw a perpendicular line from the occlusal plane to the long axis of the wisdom tooth. Draw a line at the intersection of the two lines at the occlusal plane to the second molar (Figs. 1.45 and 1.46).



**Fig. 1.45** (a, b) Mesioangular impacted middle-level wisdom tooth in the maxilla. (c) Mesially and vertically impacted high-level wisdom tooth in the maxilla. (d) Mesially and vertically impacted low-level wisdom tooth in the maxilla



**Fig. 1.45** (continued)



**Fig. 1.46** (a) Mesioangular impacted high-level wisdom tooth in the mandible. (b) Mesioangular impacted low-level wisdom tooth in the mandible. (c) Mesioangular impacted middle-level wisdom tooth in the

mandible. (d) Mesially and horizontally impacted middle-level wisdom tooth in the mandible. (e) Mesially and vertically impacted middle-level wisdom tooth in the mandible





**Fig. 1.46** (continued)

### 1.2.13 Malposition

The central axis of the second molar is located on the dental arch curve. If the central axis of the wisdom tooth is perpendicularly deviated from the dental arch curve to its buccal, palatal, or lingual side, the wisdom tooth is defined as malpositioned.

**Buccal malposition:** central axis of the maxillary or mandibular wisdom teeth is deviated to the buccal side of the dental arch curve distal to the central axis of the second molar.

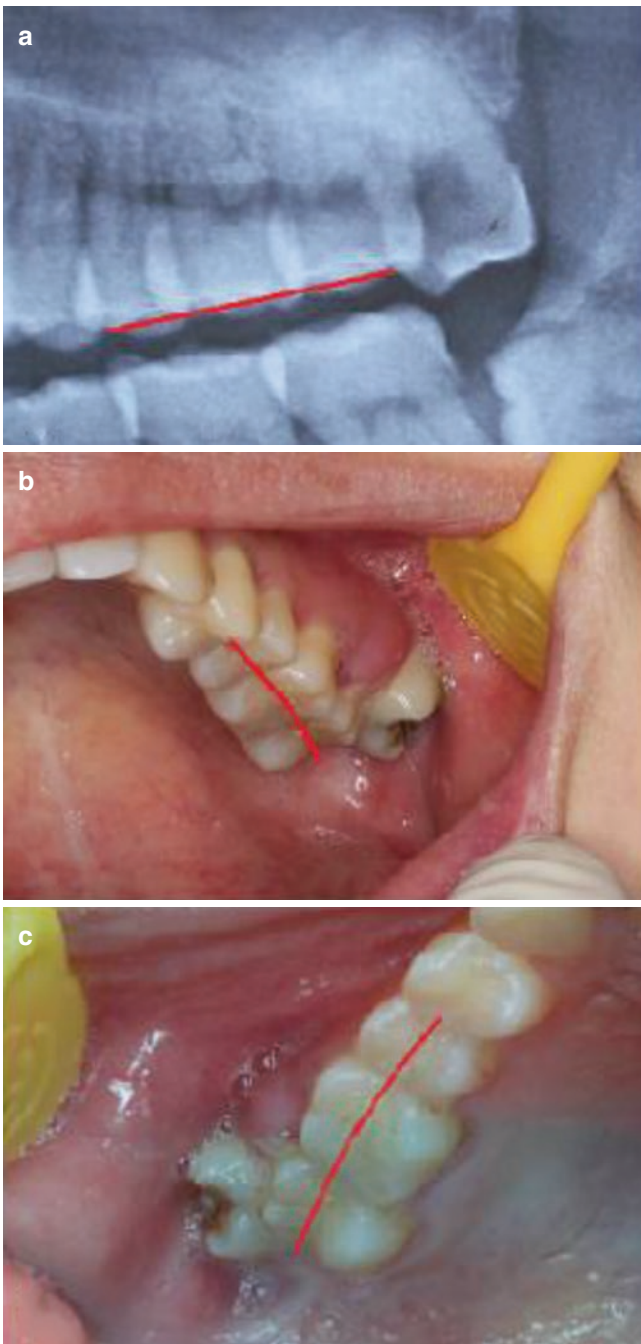
**Lingual malposition:** central axis of the mandibular wisdom teeth deviated to the lingual side of the dental arch curve distal to the central axis of the mandibular second molar.

**Palatal malposition:** central axis of the maxillary wisdom teeth deviated to the palatal side of the dental arch curve distal to the central axis of the second molar (Figs. 1.47 and 1.48).



**Fig. 1.47** (continued)

**Fig. 1.47** (a, b) The mandibular molars are arranged well from the panoramic radiograph. But in fact, the third molar does not locate within the arch curve. (c) The central axis of the wisdom tooth is buccally malpositioned. (d) The mandibular wisdom tooth is malpositioned buccally in the reflector panel



**Fig. 1.48** (a, b) In the radiograph, the left maxillary wisdom tooth has some overlap with the second molar, but it is difficult to decide which side (palatal or buccal) the wisdom tooth is located. The wisdom tooth is in a state of extrusion. The maxillary wisdom tooth is malpositioned buccally and completely deviated from the arch curve in the maxilla. (c) The wisdom tooth is firmly contacting with the distal buccal surface of the second molar. The palatal side of the wisdom tooth and the attached gingival in the posterior dentition could be observed

### 1.2.14 Buccal, Lingual, and Palatal

The “direction” refers to the direction of the crown. The crown of the wisdom teeth could be facing toward the buccal, palatal, or lingual side, but its central axis still remains within the dental arch curve (Figs. 1.49, 1.50, and 1.51).



**Fig. 1.49** Only the crown of the wisdom tooth tilts buccally, while the central axis of the wisdom tooth still locates within the dental arch curve



**Fig. 1.50** The crown of the wisdom tooth tilts lingually in the mandible, which makes the buccal gingival margin of the wisdom tooth almost on the same curve with that of the second molar. The lingual gingival margin slightly moves downward



**Fig. 1.51** Buccally malpositioned and vertically impacted high-level wisdom tooth in the mandible. It could be observed that the maxillary wisdom tooth also dislocates buccally

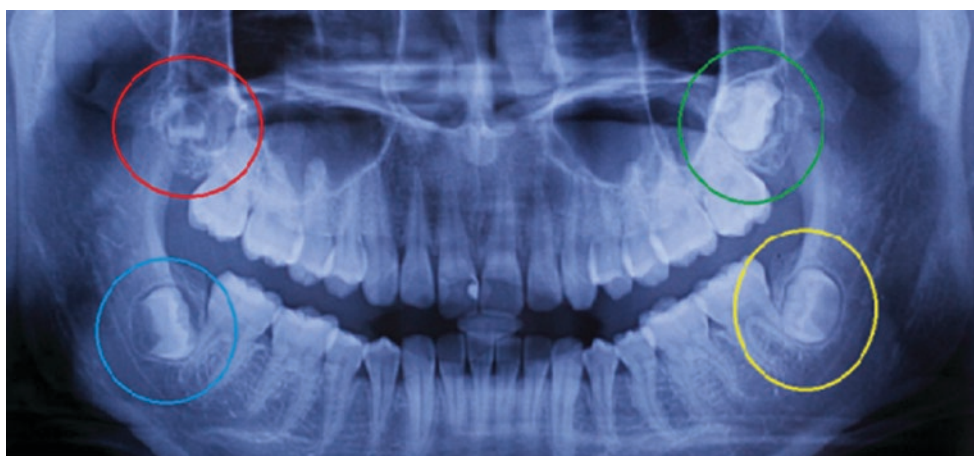
## Factors Affecting Impaction of Wisdom Teeth and Their Mechanisms

# 2

Dapeng Lu and Yi Fan

As the food chain changes in human evolution, the human maxilla went through obvious degeneration, but the number and size of teeth within the jaw did not change. As the maxilla and maxillary dentition occlude with the mandibular dentition, the mandibular teeth are constrained by the maxillary

teeth; in the meantime, the maxillary teeth limit the mandibular expansion and lateral growth. Therefore, the maxillary teeth/bone mass ratio is less than the mandibular teeth/bone mass ratio. However, the impaction rate of the wisdom tooth in the upper jaw is far less than that in the mandible.




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## 2.1 Section 1: Three Factors Affecting Wisdom Tooth Impaction

Wisdom teeth are the last ones to erupt into the dentition, and they grow in the “surplus space,” which is often not enough due to the degradation of the jaw and growth restriction as well as the limited space available. Therefore, the wisdom teeth are often impacted during eruption. There are three main factors influencing the wisdom tooth impaction: space available anterior to the wisdom tooth, inclination angle of the wisdom tooth, and space available behind the second molar. Among these, the first two are the main factors influencing the impaction of the upper wisdom tooth.

### 2.1.1 Space Available Behind Second Molar Space

The space behind the second molar is defined as the width from the height of contour of the second molar to the mandibular ramus (Fig. 2.1).



**Fig. 2.1** Normal eruption of the wisdom tooth requires the space behind the second molar wider than the width of the wisdom tooth crown. In this figure, the space is smaller than the width of the wisdom crown; therefore, the wisdom tooth cannot erupt normally

### 2.1.2 Inclination Angle of Wisdom Tooth

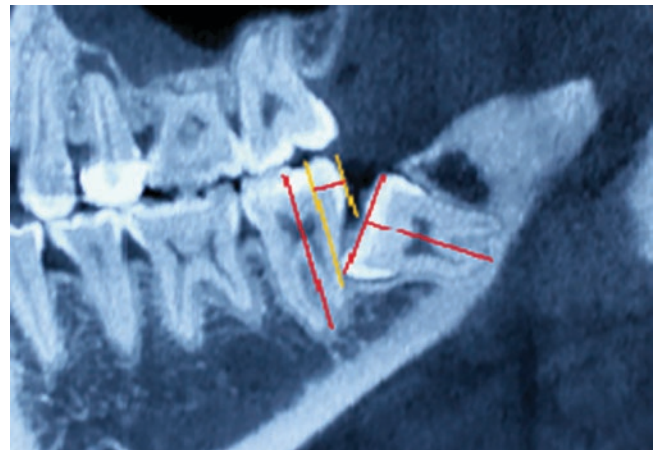
It is the angle between the long axis of the wisdom tooth and that of the second molar (Fig. 2.2).



**Fig. 2.2** One of the conditions for wisdom tooth to erupt normally is that the angle between the long axis of the wisdom tooth and that of the second molar should be less than  $26^\circ$ . In this figure, the angle is bigger than  $26^\circ$ ; therefore, the wisdom tooth cannot erupt normally

### 2.1.3 Space Available in Front of the Wisdom Tooth

Even if the space available behind the second molar is wider than the width of the wisdom tooth crown and the inclination angle of the wisdom tooth is less than  $26^\circ$ , the wisdom tooth cannot erupt normally. Lack of the space available in front of the wisdom tooth is one of the reasons causing wisdom tooth impaction (Fig. 2.3).



**Fig. 2.3** First, draw the long axis on the second molar. Second, draw a line through the concave point of the distal root of the second molar parallel to the long axis. Third, draw a line through the distal height of contour of the second molar crown parallel to the long axis. When the distance between the latter two parallel lines is less than the distance between the mesial crown edge of the wisdom tooth and the concave point of the distal root of the second molar, the wisdom tooth could erupt normally. In this figure, the distance between the two parallel lines is bigger; therefore, the wisdom tooth cannot erupt normally

## 2.2 Section 2: Mechanism of Forming Wisdom Tooth Impaction

Each tooth can accomplish the process of normal eruption when there is enough space within the jaw. Wisdom teeth are the last ones that erupt into the dentition, and they grow in the “surplus space,” which is often not enough. Therefore, wisdom teeth are often impacted in the process of eruption. The lack of space is the result of a variety of complex factors.

### 2.2.1 The Overbite of Maxillary Anterior Restricts the Forward Growth of the Mandible

The maxillary dental arch that erupted over the maxillary alveolar ridge occludes with mandibular dentition with buccal and labial overbite, which restricts the dental alignment over the mandibular alveolar ridge (Figs. 2.4, 2.5, and 2.6).



**Fig. 2.4** The anterior upper dentition occludes on the labial side of the lower dentition



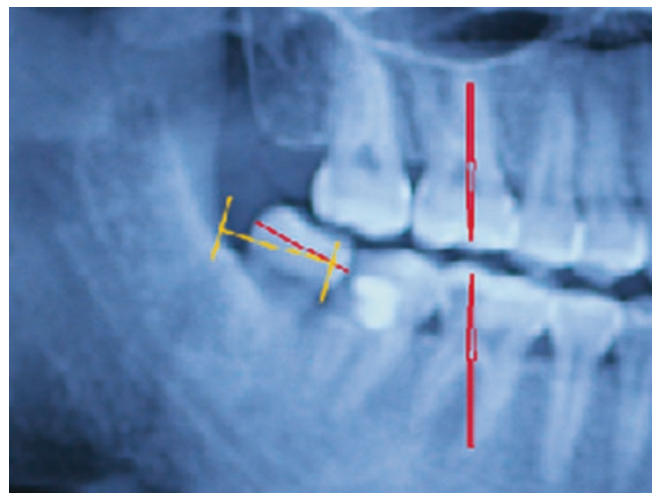
**Fig. 2.5** Lower anterior teeth are crowded



**Fig. 2.6** After the eruption of the permanent first molars (around age 6), the occlusal relationship of the upper and lower molars restricts the forward displacement of the molars and limits the forward growth of the posterior segment of the mandible. It also limits the overbite relationship between the maxillary and mandibular molars as well as the growth of the mandibular arch width. The figure indicates an Angle Class I malocclusion

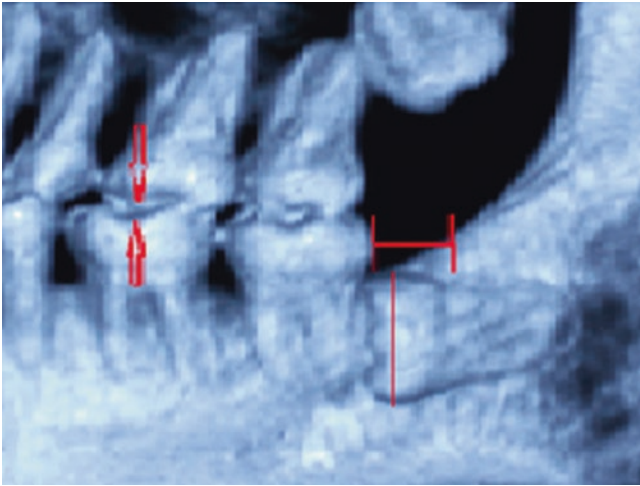
### 2.2.2 Influence of Angle Classification on Posterior Space of Second Molar

Three angle classifications are closely related to the available space posterior to the mandibular second molar. The establishment of the occlusal relationship in early childhood determines how much space is available behind the second molars. As a result, the available space posterior to the second molars has an impact on the rate of normal wisdom tooth eruption (Figs. 2.7, 2.8, and 2.9).



**Fig. 2.7** Angle Class III. The space posterior to the second molar is greater than the mesiodistal crown width of the wisdom teeth, and the eruption rate is higher in Angle Class III than the other two classifications





**Fig. 2.8** Angle Class I. The retro second molar space is often greater than that of Angle Class II and smaller than that of Angle Class III, and the eruption rate is between the other two classifications



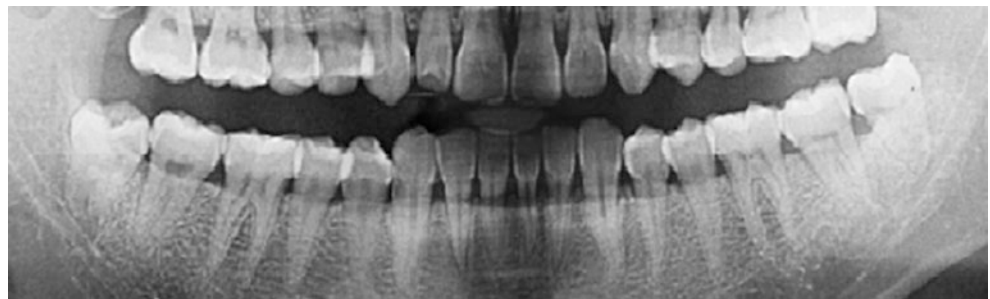
**Fig. 2.9** Angle Class II. The retro second molar space is often smaller than the length of the mesiodistal crown of the wisdom tooth, and the eruption rate is lower than the other two classifications

### 2.2.3 Effect of Mandibular Ramus Angle on Retromolar Space

The retromolar space is measured by the straight-line distance between the distal height of contour of the second molar crown and the front edge of the mandibular ramus. The distal height of contour of the second molar crown is the anterior wall of the retromolar space, and the front

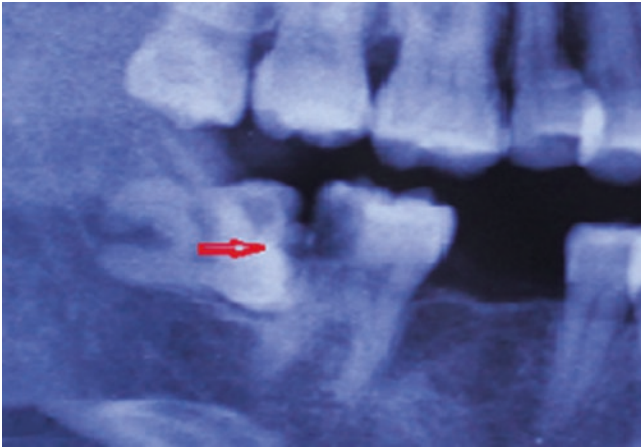
edge of the mandibular ramus is the posterior wall of the retromolar space. The retromolar space is the space available for the wisdom tooth growth and eruption. The wisdom tooth germ is produced in the lower back of this gap, developing, growing, and erupting forward and upward. Thus, the front edge of the mandibular ramus is closely related to the wisdom teeth (Figs. 2.10, 2.11, 2.12, 2.13, and 2.14).

**Fig. 2.10** The front edge of the mandibular ramus covers the distal crown edge of the wisdom tooth



**Fig. 2.11** The wisdom tooth is inverted and almost wrapped by the anterior edge of the mandibular ramus. The retromolar space is very narrow



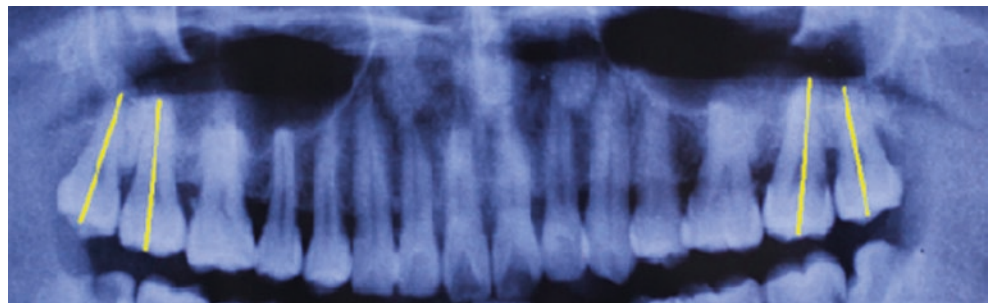


**Fig. 2.12** The most part of the wisdom tooth is embedded in the anterior edge of the mandibular ramus, except the distal edge of the crown. The retromolar space is smaller than the mesiodistal distance of the crown



**Fig. 2.13** The retromolar space is much larger than the mesiodistal distance of the crown. The retromolar space and the anterior edge of the mandibular ramus have no effect on the eruption of wisdom teeth. The longer mandibular body has a positive effect over the retromolar space and the anterior edge of the mandibular ramus on the wisdom teeth

**Fig. 2.14** The morphology and structure of the maxilla are different from the mandible. There is maxillary tuberosity in the maxilla. The impacted maxillary wisdom teeth are less, and even the vertical impaction is mainly due to the obstruction of the distal height of contour of the second molar crown

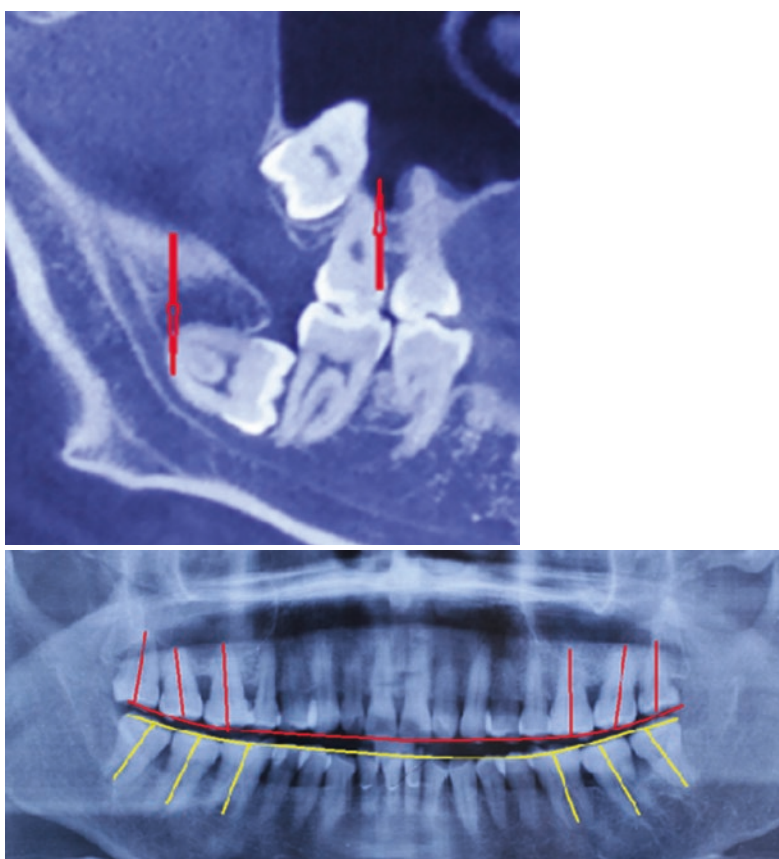


## Adjacent Relationship of Wisdom Teeth

# 3

Dong Ji, Dapeng Lu, and Yi Fan

From a tooth germ to full eruption or impaction in the jaw, there is close connection between the wisdom tooth and the adjacent tissue. This anatomical relationship is the basis for various diseases.



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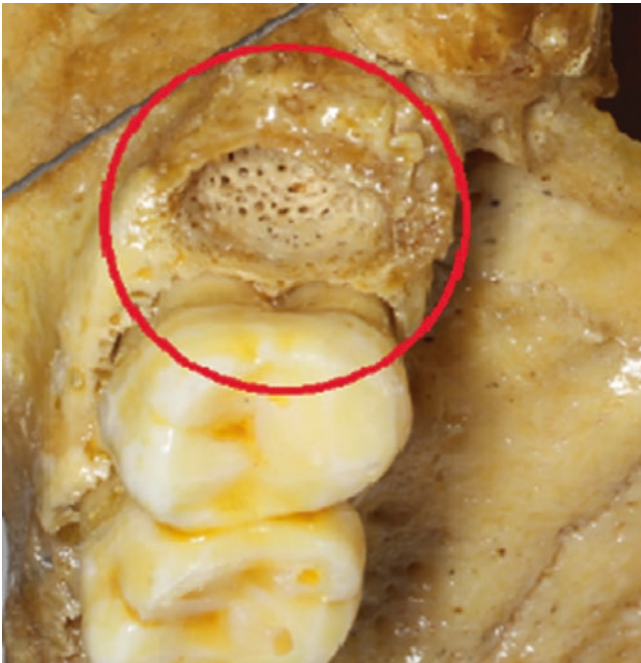
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### 3.1 Section 1: Adjacent Relationship of Maxillary Wisdom Teeth

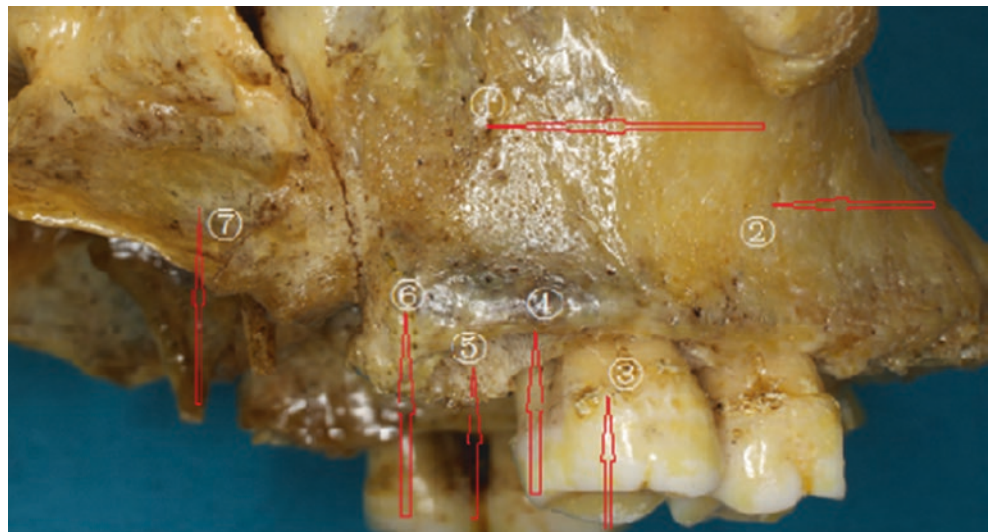
It is important to know the adjacent relationship of a normally positioned wisdom tooth before the extraction. When a wisdom tooth is impacted, a series of diseases could be induced, which could increase the difficulty of surgical extraction. The maxillary impaction mainly brings damage to the maxillary second molar.

The anatomic landmarks of maxillary wisdom teeth and their surroundings (Figs. 3.1 and 3.2).



**Fig. 3.1** The socket of the maxillary wisdom tooth locates within upper alveolar bone. There are lots of small holes within the socket which forms the cribriform plate

**Fig. 3.2** The adjacent structure of maxillary wisdom tooth. ① Alveolar hole, ② zygomatic pillar, ③ the second molar, ④ buccal alveolar ridge, ⑤ wisdom tooth socket, ⑥ maxillary tuberosity, and ⑦ external pterygoid plate

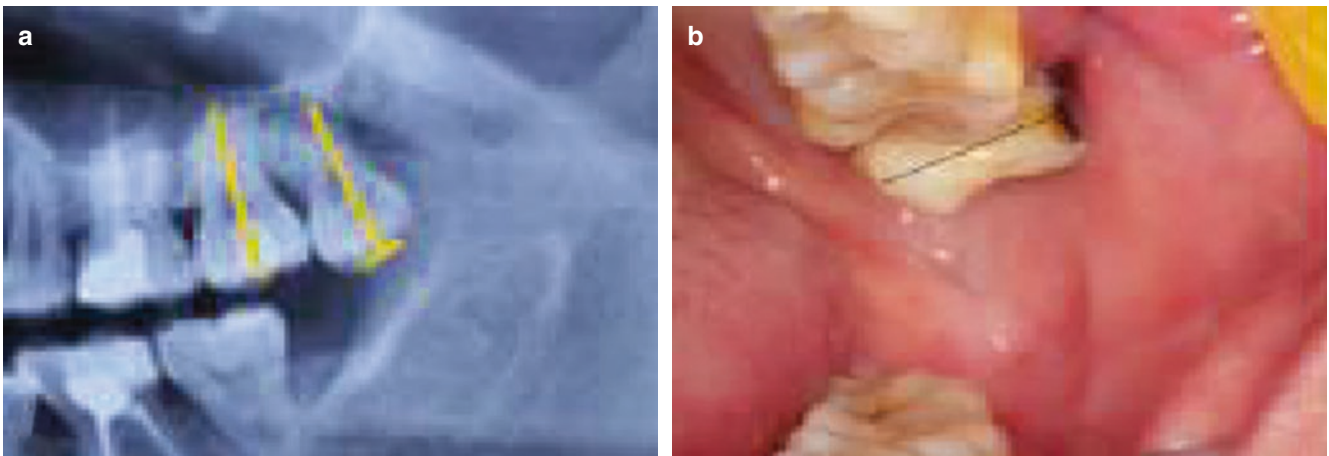


#### 3.1.1 Relation to Maxillary Second Molar

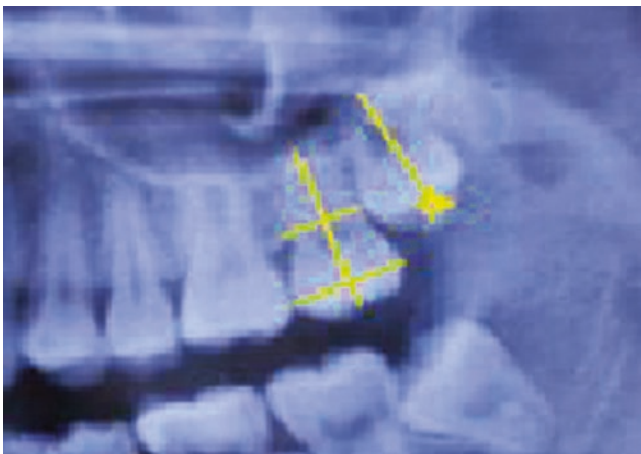
The second molar is always in a normal position, and therefore, it is often used to determine whether the wisdom tooth is impacted or not. When the wisdom tooth is impacted, the relationship between the wisdom tooth and the second molar is always destroyed (Figs. 3.3, 3.4, 3.5, 3.6, 3.7, and 3.8).



**Fig. 3.3** The long axis of the wisdom tooth is parallel to that of the second molar. The occlusal plane of the wisdom tooth is at the same level with that of the second molar



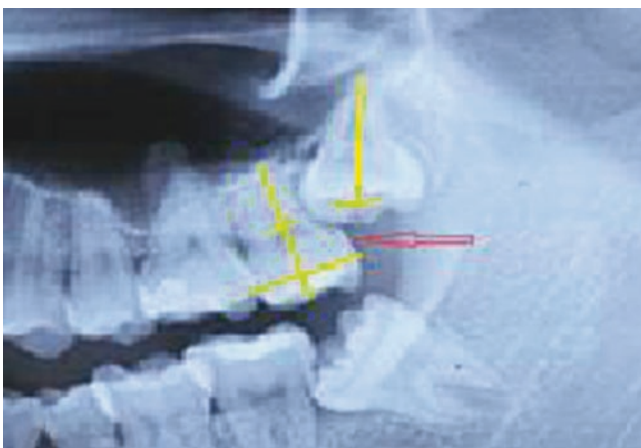
**Fig. 3.4** (a, b) The wisdom tooth extruded. The occlusal plane of the wisdom tooth is not at the same level with that of the second molar



**Fig. 3.5** The occlusal plane of the wisdom tooth is higher than that of the second molar, and the interalveolar septum disappears

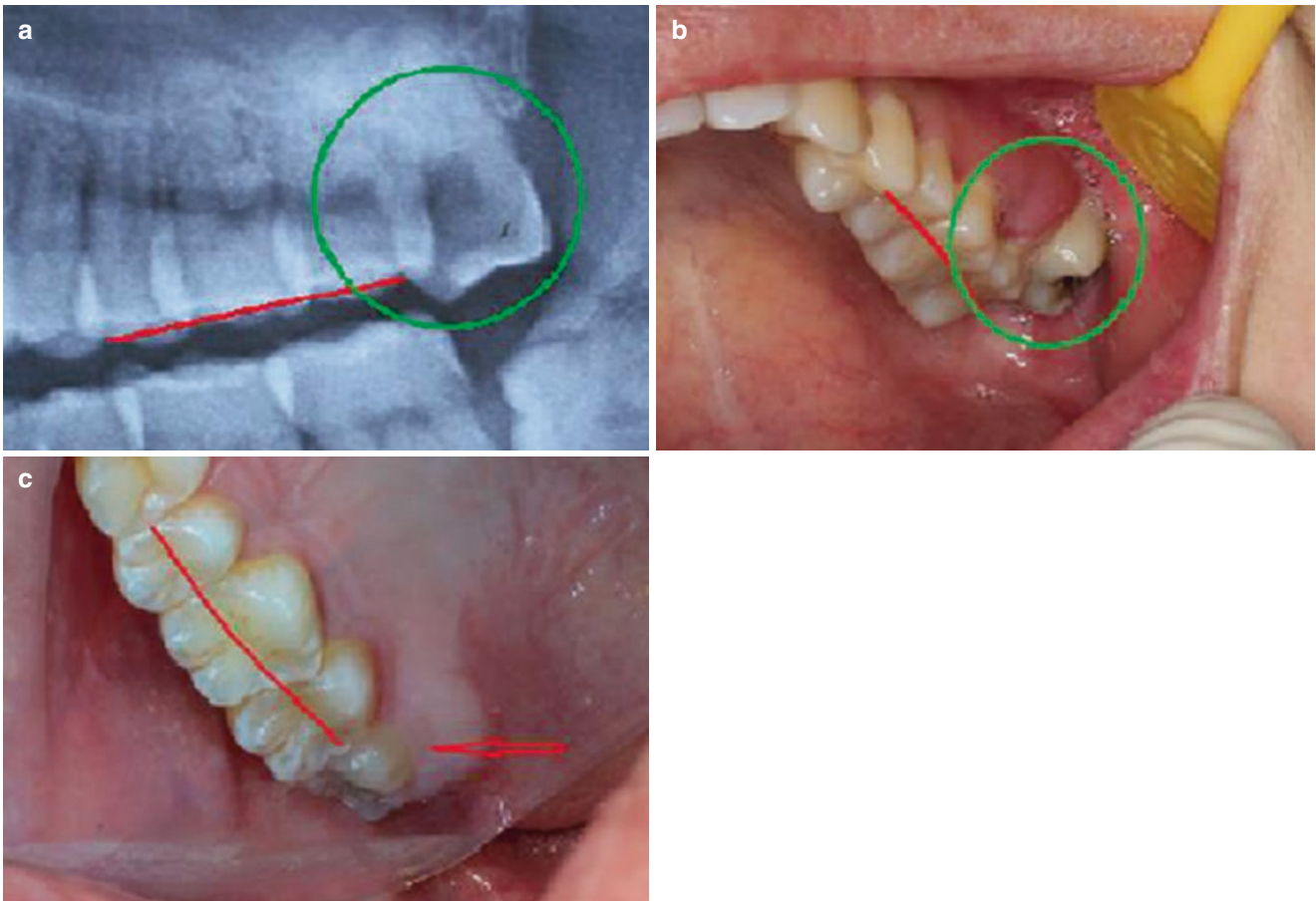


**Fig. 3.7** The mesial angular wisdom tooth embedded into the second molar, which makes the crowns and roots of the second and first molar push onto each other



**Fig. 3.6** The mesial edge of the crown of the wisdom tooth embedded into the neck and root of the second molar





**Fig. 3.8** (a) The left maxillary wisdom tooth extrudes and overlaps with the second molar from radiographic examination. (b) The left maxillary wisdom tooth malpositioned and tilted toward the buccal

side. The crown of the wisdom tooth occupies the buccal attached gingiva. (c) The palatal attached gingiva of the wisdom tooth displaces toward the buccal side

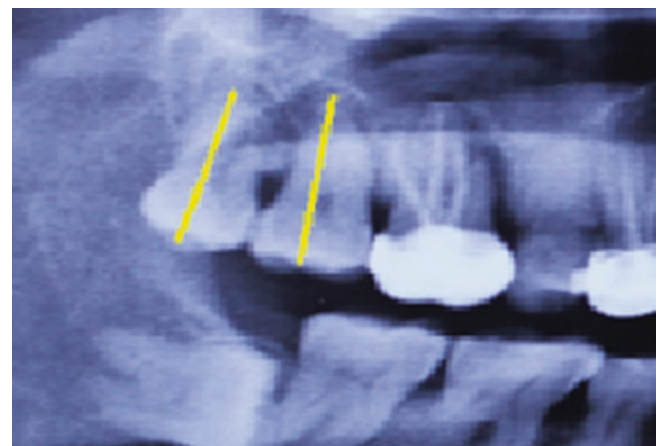
### 3.1.2 Relation to Mandibular Teeth

The maxillary teeth normally occlude cover the mandibular teeth. When the maxillary or mandibular wisdom teeth or

both of them are impacted, the local occlusal relationship changes (Figs. 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22, 3.23, 3.24, and 3.25).

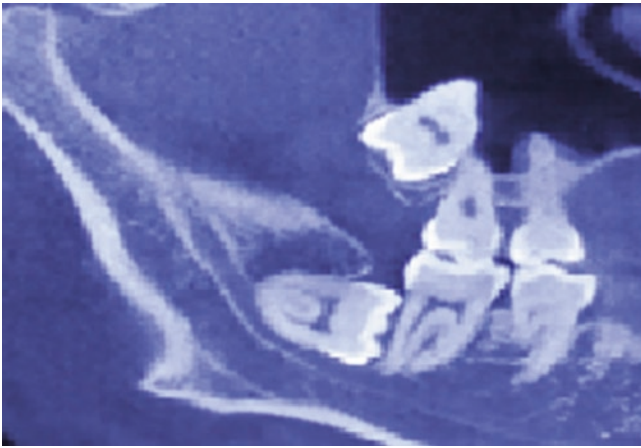


**Fig. 3.9** The normal occlusion between the upper and the lower teeth



**Fig. 3.10** The normally positioned maxillary wisdom tooth occludes over the mucosa in the posterior area of the molar

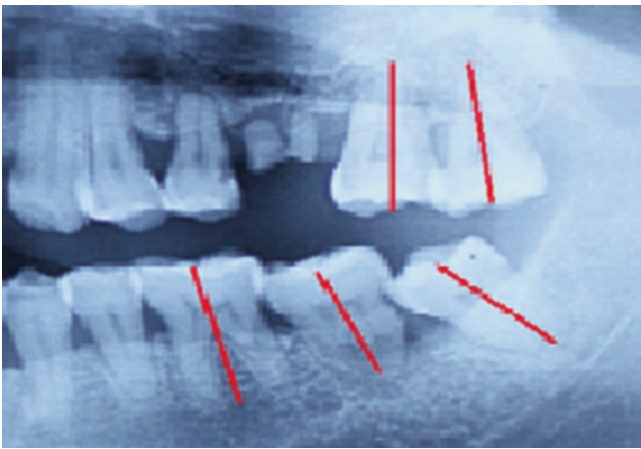




**Fig. 3.11** The maxillary and mandibular wisdom teeth are embedded in the jaws, respectively. There is no direct connection between them



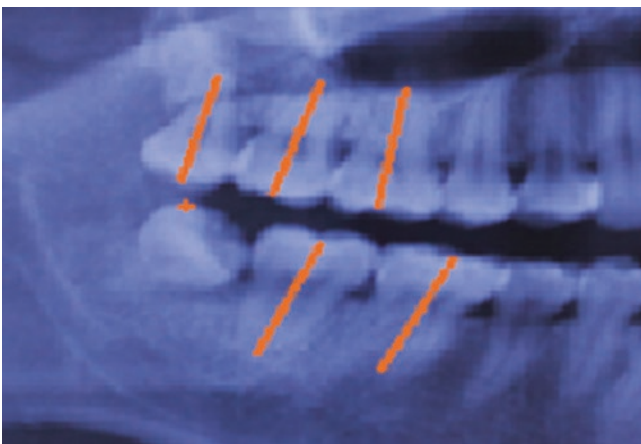
**Fig. 3.14** The mandibular wisdom tooth is horizontally embedded at a low-level site. The maxillary wisdom tooth elongates toward the space



**Fig. 3.12** The normally positioned maxillary wisdom tooth occludes with the distal edge of the mandibular crown, producing a lateral force to the second molar (fused root) and makes it tilting forward



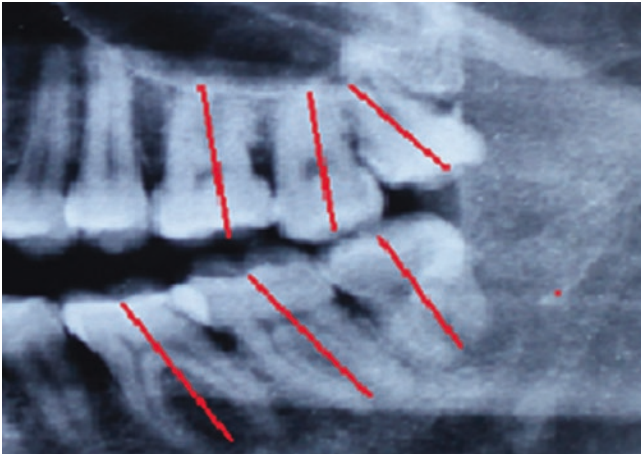
**Fig. 3.15** The maxillary wisdom tooth is pushing toward the front tooth, which squeezes out the second molar. The distal occlusal surface of the second molar occludes at the distal crown edge of the mandibular wisdom tooth, which makes the wisdom tooth tilt. The density of the mesial alveolar bone of the wisdom tooth decreases



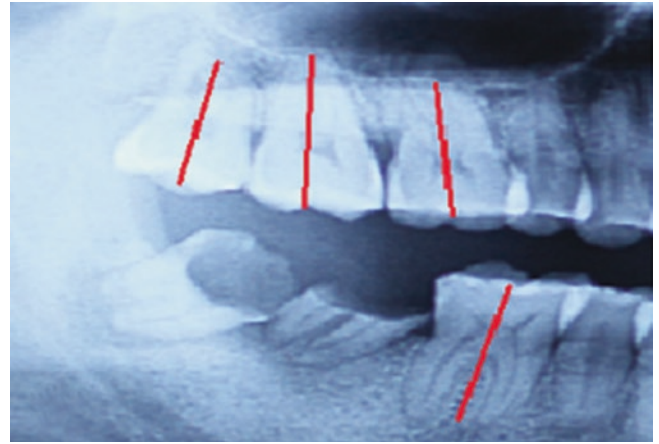
**Fig. 3.13** The normally positioned maxillary wisdom tooth occludes with the distal edge of the mandibular crown. No resistance is from the wisdom tooth to the second molar for the enough space in front of the wisdom tooth



**Fig. 3.16** Obvious extrusion of the maxillary wisdom tooth



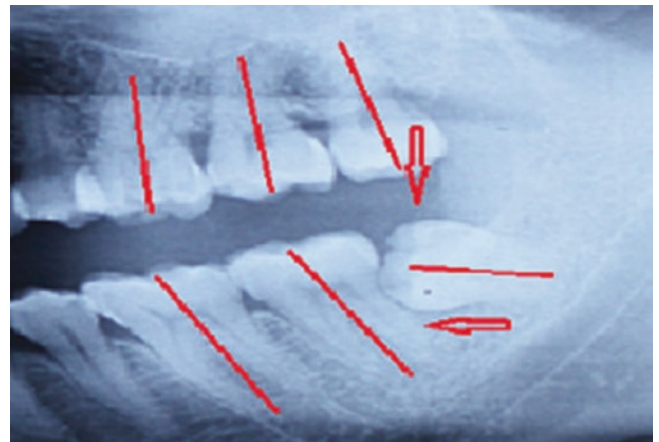
**Fig. 3.17** The maxillary second molar is pushed, but the distal occlusal of the second molar occludes with the mesial part of the mandibular wisdom tooth



**Fig. 3.19** The maxillary wisdom tooth is in normal position. The mandibular wisdom tooth and the second molar tilt to the mesial. The decayed teeth only have residual roots



**Fig. 3.18** The mandibular wisdom tooth may grow toward the space where there is no wisdom tooth in the maxilla



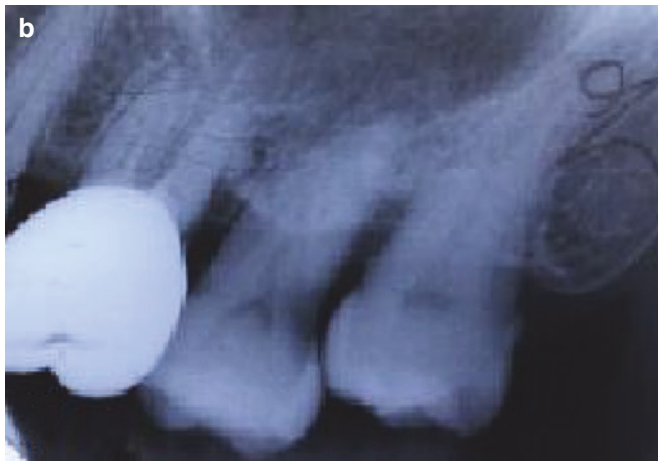
**Fig. 3.20** Occlusal force passes from the maxillary wisdom tooth to the mandibular wisdom tooth. The mandibular wisdom tooth tilted forward and embedded into the distal cervical parts of the second molar



**Fig. 3.21** (a, b) Maxillary and mandibular molar dentition. (c) Maxillary and mandibular dentition in occlusion



**Fig. 3.21** (continued)

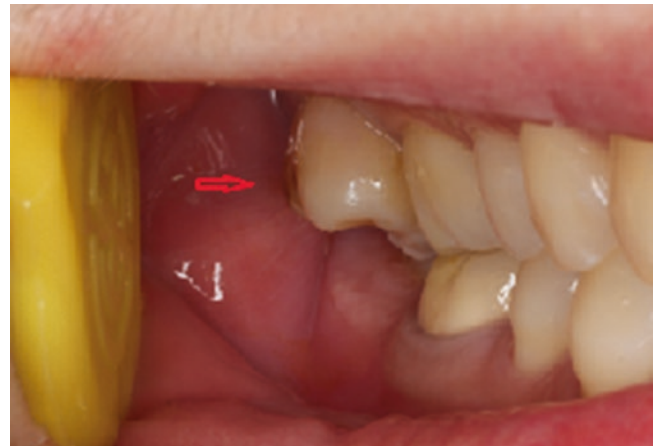


**Fig. 3.22** (a, b) The occlusal surfaces of the three molars are not at the same level. The wisdom tooth is higher than the occlusal surface of the second molar. The mesial marginal edge of the crown of the wisdom

tooth pushes against the distal height of contour of the crown of the second molar



**Fig. 3.23** The wisdom tooth pushes the second molar toward the buccal side



**Fig. 3.24** The palatal side of the maxillary second molar occludes at the buccal side of the mandibular second molar

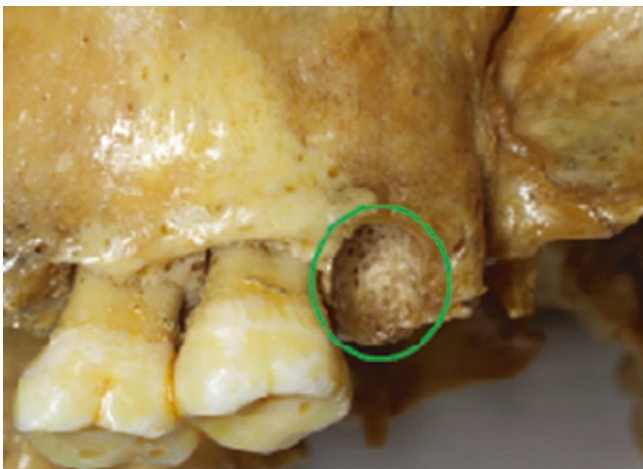




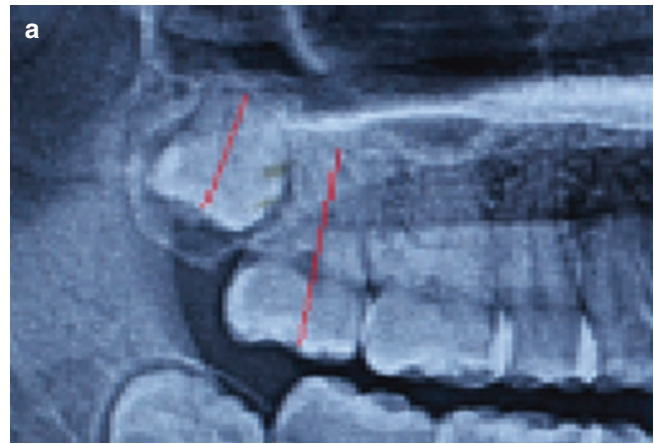
**Fig. 3.25** The maxillary second molar extruded. The mesially and vertically impacted maxillary wisdom tooth at middle level

### 3.1.3 Relation to Alveolar Bone

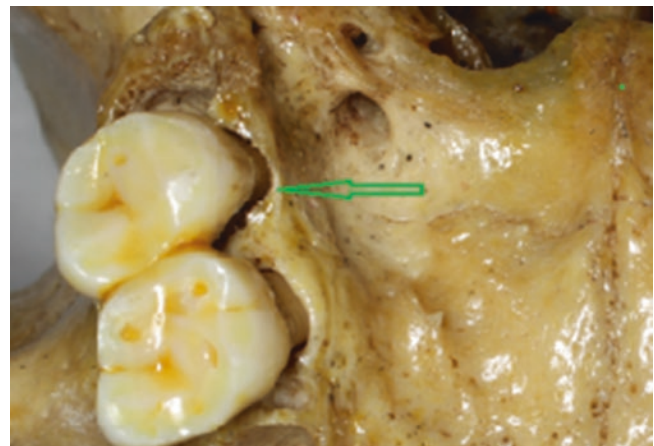
For the normally positioned wisdom teeth, only roots are embedded in the alveolar bones. As there are large variations in terms of the depth of tooth impaction and the shape and the location of the tooth, the relationship between the wisdom tooth and the alveolar bone may vary (Figs. 3.26, 3.27, 3.28, 3.29, and 3.30).



**Fig. 3.26** The roots of the maxillary wisdom tooth are surrounded by the alveolar bone. There is alveolar septum between the maxillary wisdom tooth and the second molar, which is the cancellous bone and the weakest wall surrounding the wisdom tooth



**Fig. 3.27** (a, b) The long axis of the maxillary wisdom tooth is parallel to that of the second molar. The alveolar septum between the mesial of wisdom tooth and the distal root of the second molar completely disappeared



**Fig. 3.28** The inner and outer wall of the maxillary wisdom tooth root is thin but surrounded by cancellous bone