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Identification of Human Teeth

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Introduction

The illustrations and descriptions that are presented here are a practical guide prepared to assist in the recognition of the teeth of *Homo sapiens* by selectively identifying for each tooth the most salient features that may be readily observed. No attempt has been made to give a complete anatomical description of the teeth which may be found in standard textbooks of dental anatomy (Osborn, 1981; Scott and Symons, 1982; Van Beek, 1983; Ash, 1984).

In preparing the illustrations the teeth have been slightly idealised to make the chosen identifying features as clear as possible. However it must not be overlooked that there may be considerable morphological variations, some arising from expected normal variation, some of which may be inherited and others which arise as pathological malformations. These are very well described with line drawings by Taylor (1978) and many photographs of the different tooth shapes are included in Ash's (1984) comprehensive studies. Even though the teeth that are found from early historical sites may be severely worn as a result of attrition, there are usually enough features and characteristics remaining to enable most teeth to be identified, but as these are increasingly worn away it becomes more difficult, especially to distinguish left from right sided teeth.

The size of a tooth is a useful guide to its identification, especially when the teeth are all from the same skull. The mean figures for crown height (CH), root length (RL), mesiodistal width (MDW) and labiolingual width (LLW), or buccolingual width (BLW) have been given with each illustration and a summary of these data are given in Tables 1 and 2. In giving these measurements it must always be remembered that they have been derived from an array of sources. There are large variations in size between and within populations as is shown by the early studies on Eskimo dentitions by Pedersen (1949), Norwegian Lapp dentitions by Selmer-Olsen (1949) and more recently Moorrees' study (1959) on the Aleuts. There are differences in size between the teeth of males and females and these differences are summarised by Sassouni and Forrest (1971). However, Hanihara (1978) looking at differences of tooth size in several populations concluded that these differences between males and females may be relatively large in some populations but relatively small in others. Whatever the size may be, the role of inheritance in determining size should not be overlooked. Goose (1971) demonstrated a high degree of heritability among British families. The influence of wear on tooth size at three stages of attrition is

TABLE 1 Average dimensions of the deciduous teeth

Tooth	Crown height CH (mm)	Root length RL (mm)	Mesiodistal width MDW (mm)	Labiolingual or buccolingual width LLW or BLW (mm)
Maxilla				
1st incisor	6.0	10.0	6.5	5.0
2nd incisor	5.6	10.2	5.2	4.0
Canine	6.5	13.0	6.8	7.0
1st molar	5.1	10.0	7.1	8.5
2nd molar	5.7	11.7	8.4	10.0
Mandible				
1st incisor	5.0	9.0	4.0	4.0
2nd incisor	5.2	9.8	4.5	4.0
Canine	6.0	11.2	5.5	4.9
1st molar	6.0	9.8	7.7	7.0
2nd molar	5.5	12.5	9.7	8.7

This and the subsequent tables are derived from Van Beek (1983) who had made minor modifications to the data from Logan and Kronfeld (1933).

TABLE 2 Average dimensions of the permanent teeth

Tooth	Crown height CH (mm)	Root length RL (mm)	Mesiodistal width MDW (mm)	Labiolingual or buccolingual width LLW or BLW (mm)
Maxilla				
1st incisor	10.5	13.0	8.5	7.0
2nd incisor	9.0	13.0	6.5	6.0
Canine	10.0	17.0	7.5	8.0
1st premolar	8.5	14.5	7.0	9.0
2nd premolar	8.5	14.0	7.0	9.0
1st molar	7.5	12.5	10.5	11.0
2nd molar	7.0	11.5	9.5	11.0
3rd molar	6.5	11.0	8.5	10.0
Mandible				
1st incisor	9.0	12.5	5.0	6.0
2nd incisor	9.5	14.0	5.5	6.5
Canine	11.0	15.5	7.0	7.5
1st premolar	8.5	14.0	7.0	7.5
2nd premolar	8.0	14.5	7.0	8.0
1st molar	7.5	14.0	11.0	10.0
2nd molar	7.0	12.0	10.5	10.0
3rd molar	7.0	11.0	10.0	9.5

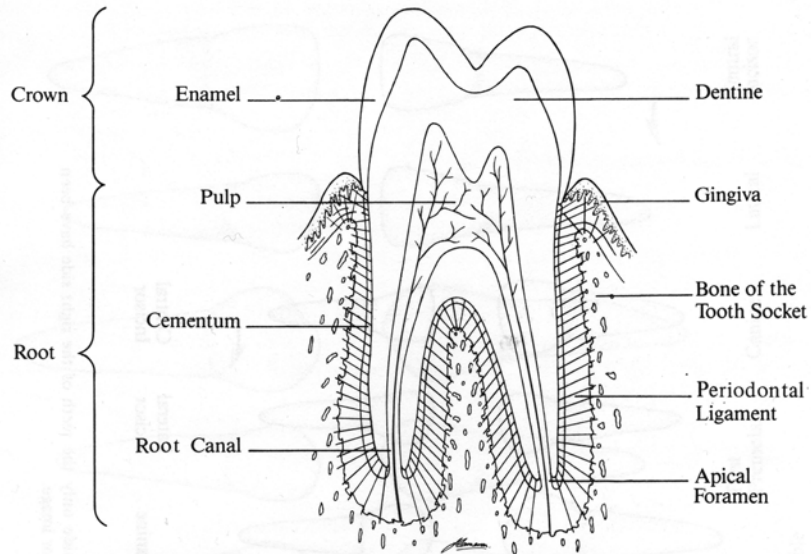


Fig. 1 The tissues of a human tooth. The enamel, dentine and cementum are all mineralised and are very resistant to destruction.

demonstrated by a comprehensive array of measurements which consider not only tooth loss on the occlusal surface but as well the loss of interstitial tooth size at the point of tooth contact (Van Reenan, 1982). The association of age with wear has been described by Miles (1963).

A brief description with illustrations is given of the structure of a tooth and the appearance of the deciduous and permanent teeth at different stages of their crown and root formation (Figs 1, 5a, b). The basic distinctions between deciduous and permanent teeth and between maxillary and mandibular permanent teeth are listed. The differences between right and left sided teeth will be apparent from the individual illustrations of the teeth. A glossary of all special terms is included in an appendix.

In addition to the identification of a tooth it is possible if the tooth is not fully formed to make an assessment of the age of the individual from which the tooth came. If the tooth is found in the jaw or even a fragment of the jaw, the extent that the tooth has erupted may be evaluated, and this can give some further indication of age.

Description of a tooth

A tooth is composed of three mineralised tissues: enamel, dentine and cementum, which surround a central pulp of soft connective tissues containing the blood vessels and

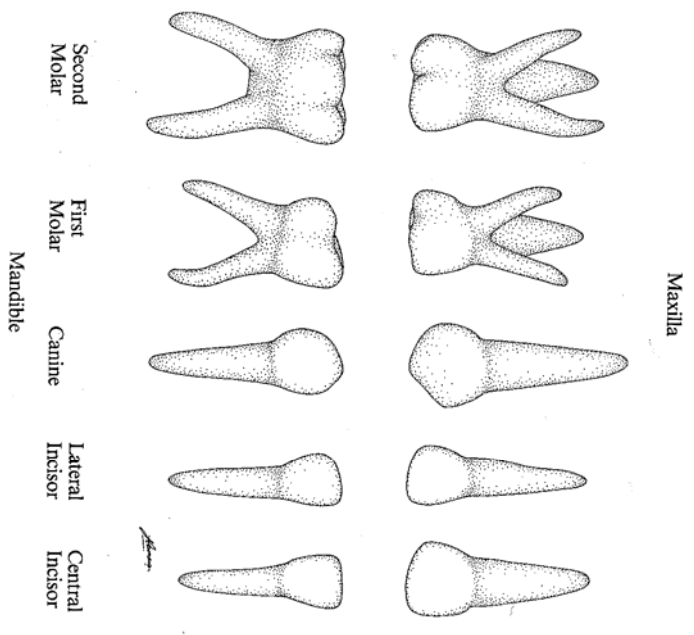


Fig. 2 The deciduous dentition. Throughout this guide only the teeth of the right side have been illustrated. The teeth of the left side are a mirror image.

IDENTIFICATION OF HUMAN TEETH

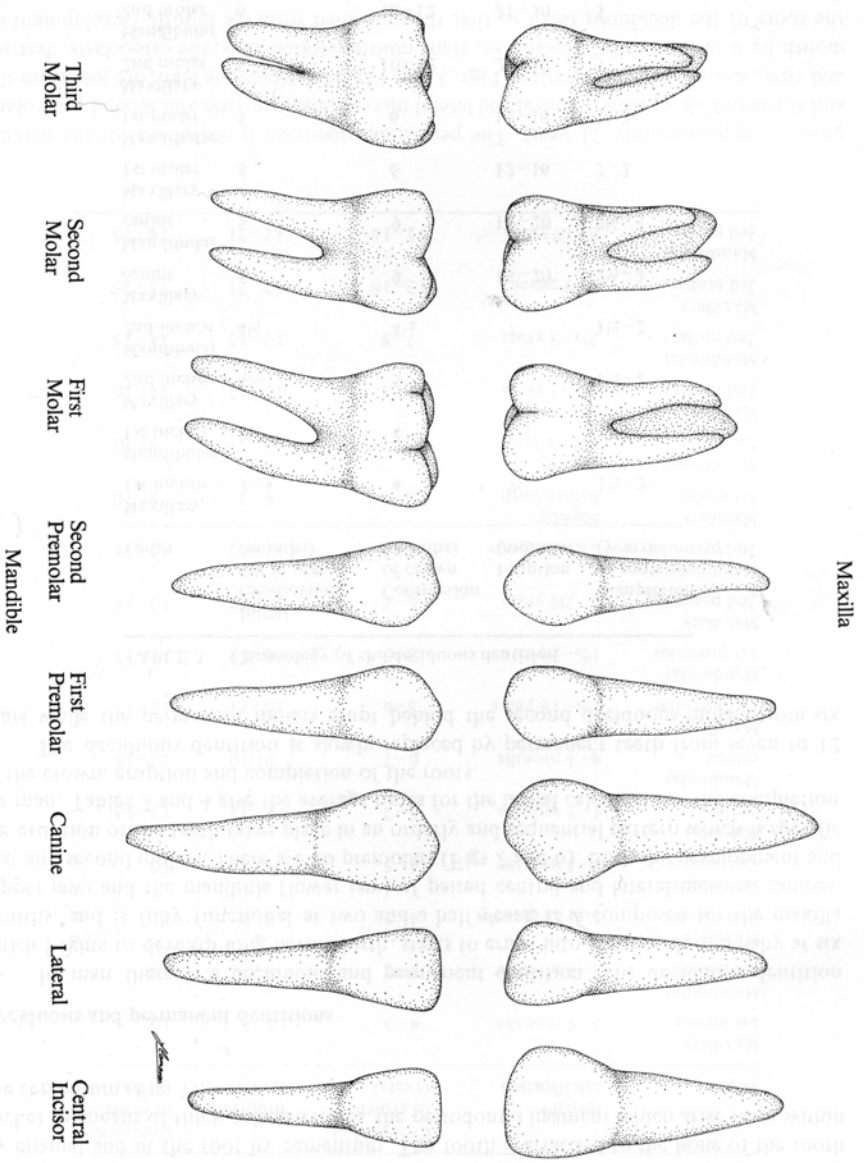


Fig. 3 The permanent dentition.

nerves. Next to the pulp is the dentine a tubular structure which in the crown is covered by enamel and in the root by cementum. The tooth is attached to the bone of the tooth socket by means of thick collagen fibres, the periodontal ligament which arise from within the cementum (Fig. 1).

Deciduous and permanent dentitions

In man there is a deciduous and permanent dentition. The deciduous dentition which begins to develop long before birth, starts to erupt into the mouth of a baby at six months, and is fully functional at two and a half years. It is composed for the maxilla (upper jaw) and the mandible (lower jaw) of paired central and lateral incisors, canines, first and second molars. There are no premolars (Figs 2 and 6). Both the development and the eruption of the teeth takes place in an orderly and sequential pattern which is specific for man. Tables 3 and 4 give the average times for the initial calcification, the completion of the crown, eruption and completion of the roots.

The deciduous dentition is slowly replaced by permanent teeth from seven to 12 years while the permanent molars erupt behind the second deciduous molars from six

TABLE 3 Chronology of the deciduous dentition

Tooth	Initial calcification (all <i>in utero</i>) (months)	Completion of crown (months)	Eruption (months)	Completion of roots (years)
Maxillary 1st incisor	3-4	4	7½	1½-2
Mandibular 1st incisor	4½	4	6½	1½-2
Maxillary 2nd incisor	4½	5	8	1½-2
Mandibular 2nd incisor	4½	4½	7	1½-2
Maxillary canine	5	9	16-20	2½-3
Mandibular canine	5	9	16-20	2½-3
Maxillary 1st molar	5	6	12-16	2-2
Mandibular 1st molar	5	6	12-16	2-2
Maxillary 2nd molar	6	10-12	21-30	3
Mandibular 2nd molar	6	10-12	21-30	3

TABLE 4 Chronology of the permanent dentition

Tooth	Initial calcification	Completion of crown (years)	Eruption (years)	Completion of roots (years)
Maxillary 1st incisor	3-4 months	4-5	7-8	10
Mandibular 1st incisor	3-4 months	4-5	6-7	9
Maxillary 2nd incisor	10-12 months	4-5	8-9	11
Mandibular 2nd incisor	3-4 months	4-5	7-8	10
Maxillary canine	4-5 months	6-7	11-12	13-15
Mandibular canine	4-5 months	6-7	9-10	12-14
Maxillary 1st premolar	1½-18 years	5-6	10-11	12-13
Mandibular 1st premolar	1¾-2 years	5-6	10-12	12-13
Maxillary 2nd premolar	2-2½ years	6-7	10-12	12-14
Mandibular 2nd premolar	2¼-2½ years	6-7	11-12	13-14
Maxillary 1st molar	Slightly before birth	2½-3	6-7	9-10
Mandibular 1st molar	Slightly before birth	2½-3	6-7	9-10
Maxillary 2nd molar	2½-3 years	7-8	12-13	14-16
Mandibular 2nd molar	2½-3 years	7-8	12-13	14-15
Maxillary 3rd molar	7-9 years	12-16	17-21	18-25
Mandibular 3rd molar	8-10 years	12-16	17-21	18-25

years to approximately 21 years. The permanent dentition is composed for the maxilla and the mandible of paired central and lateral incisors, canines, first and second premolars, and first, second and third molars (Figs. 3 and 12). The deciduous teeth are lost from the mouth by a process called resorption; giant multinucleated cells, the osteoclasts, destroy the roots of the deciduous teeth so that they are shed from the mouth. Development of the permanent teeth begins before birth but only the crown of the first permanent molar

has begun to be mineralised (Table 4). If complete jaws or fragments of the jaws of young individuals are found the smooth outline of the bony crypts in which the teeth may be forming may be readily recognised.

Developing teeth

Fig. 4a, b shows the appearance and location of the deciduous teeth and of the developing permanent teeth at three years of age and at 21 years. Because partially developed teeth may often be found the sequence of tooth development and the appearance of the teeth between the ages of three and 12 years are shown in Fig. 5a, b. As a general rule, the several stages of permanent tooth development, especially the time for root completion, are more advanced in girls than boys (Nolla, 1960). The complete chronology of tooth development is given in Tables 3 and 4. The following points should be noted:

The deciduous teeth

1. All the deciduous teeth are partially mineralised before birth, and so there would be only a slight chance that they could survive a prolonged burial.
2. The roots of the deciduous teeth are completely formed approximately one year after the teeth have erupted into the mouth.

The permanent teeth

1. Only the first permanent molars begin to mineralise before birth.
2. The crowns of the permanent teeth take four or more years to form except for the first permanent molars which are formed in three years.
3. In the sequence of eruption the mandibular tooth usually erupts before its maxillary counterpart except for the second premolar which erupts in the maxilla before the mandible.
4. Eruption takes place three to five years after the crown has been fully formed.
5. The roots of the teeth are completely formed approximately three years after the teeth have erupted and become fully functional.

Distinction between deciduous and permanent teeth (Figs 2, 3 and Tables 1, 2).

The deciduous dentition may usually be distinguished from the permanent teeth by the following characteristics:

1. The incisors and canines are markedly smaller than their successor permanent teeth.
2. The molars are larger than the premolars which replace them.

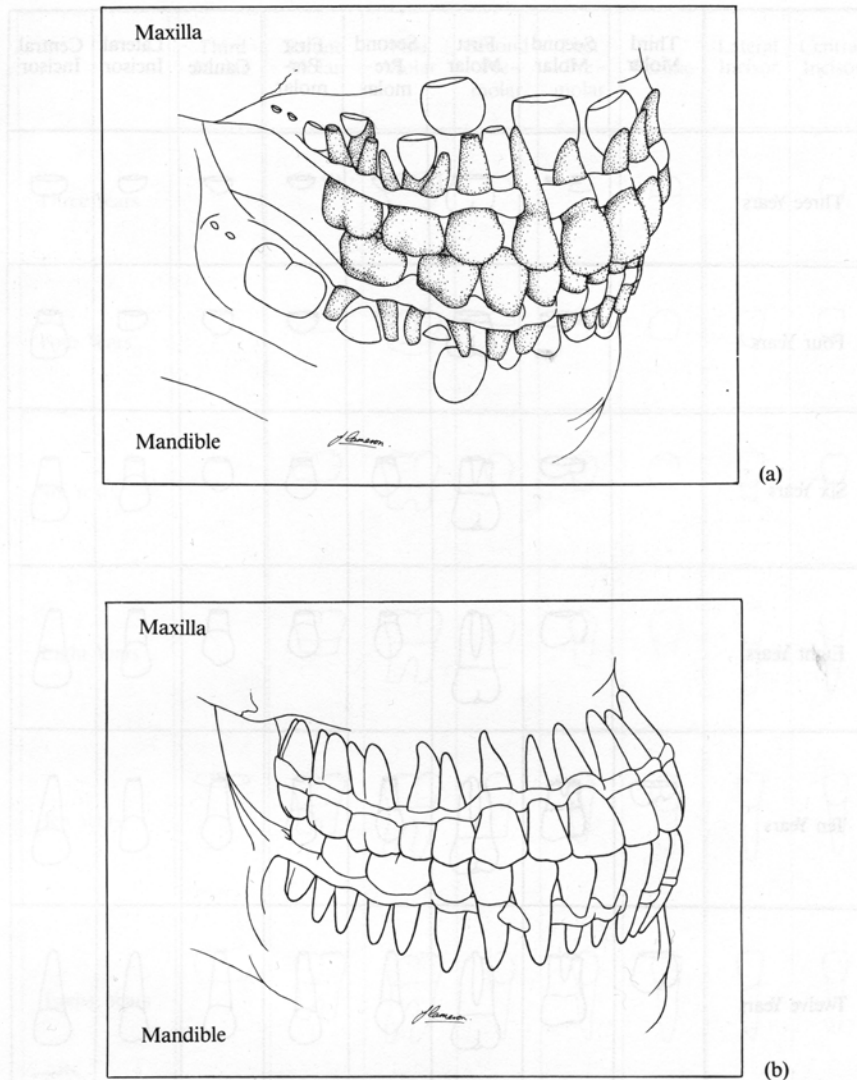














































Fig. 4 The deciduous and permanent dentitions in the maxilla and mandible. (Based on van der Linden and Duterloo, 1976.) (a) The deciduous dentition at three years is erupted and fully formed. The permanent teeth are shown in several stages of development. Note the position of the premolars forming between the roots of the deciduous molars. (b) The permanent teeth at 21 years.

	Third Molar	Second Molar	First Molar	Second Pre-molar	First Pre-molar	Canine	Lateral Incisor	Central Incisor
Three Years								
Four Years								
Six Years								
Eight Years								
Ten Years								
Twelve Years								

(a)

Fig. 5 (a) The permanent maxillary teeth at different stages of development (\pm six months).

	Third Molar	Second Molar	First Molar	Second Pre-molar	First Pre-molar	Canine	Lateral Incisor	Central Incisor
Three Years								
Four Years								
Six Years								
Eight Years								
Ten Years								
Twelve Years								

(b)

Fig. 5 (b) The permanent mandibular teeth at different stages of development (\pm six months). (Based on Schour and Massler, 1944.)

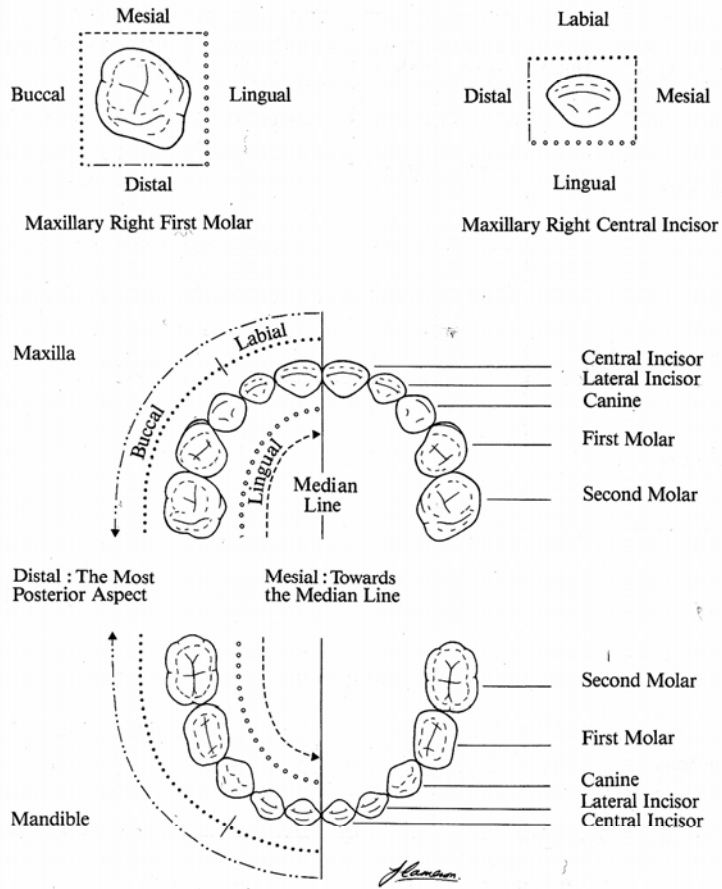


Fig. 6 The occlusal appearance of the deciduous dentition. The varying line symbols are used for all the illustrations. Note that *labial* refers to the central and lateral incisors and *buccal* to the canine and molars.

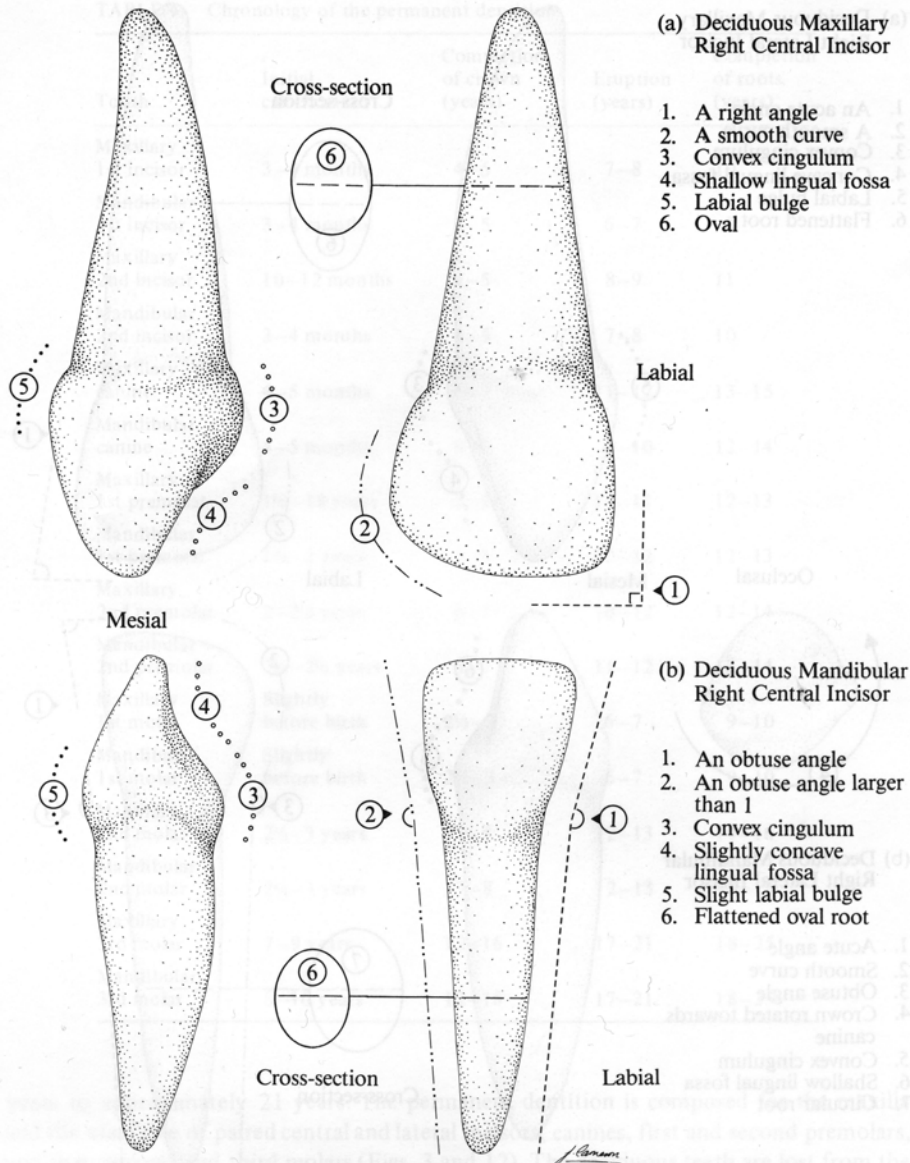
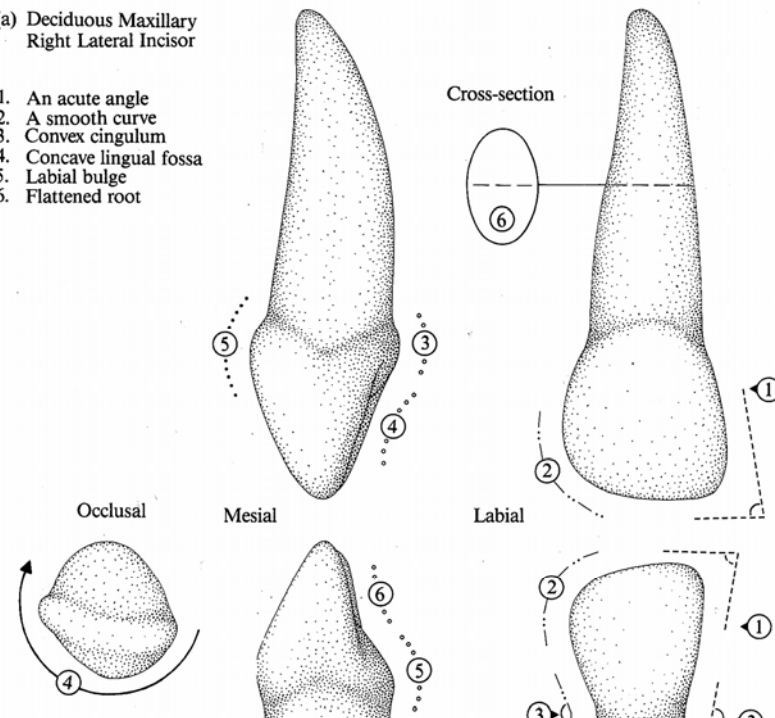


Fig. 7 The deciduous central incisors. (a) Maxillary dimensions (mm): CH 6.0, RL 10.0, MDW 6.5, LLW 5.0. (b) Mandibular dimensions (mm): CH 5.0, RL 9.0, MDW 4.0, LLW 4.0.

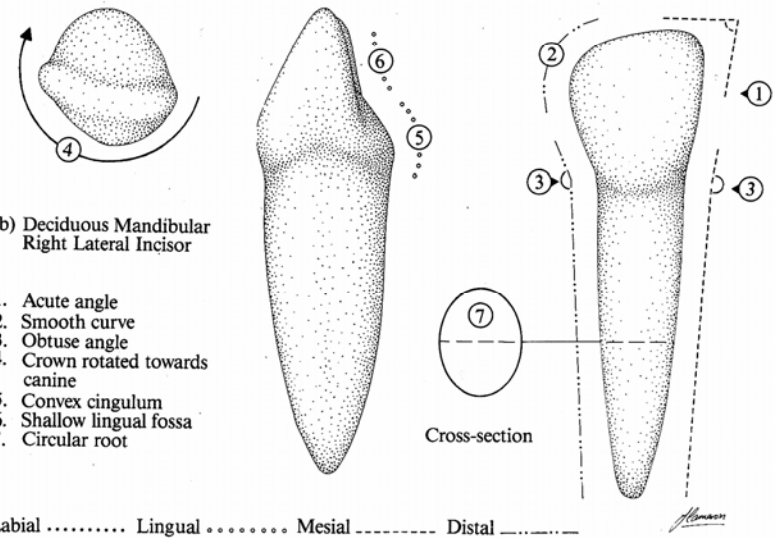
(a) Deciduous Maxillary Right Lateral Incisor

1. An acute angle
2. A smooth curve
3. Convex cingulum
4. Concave lingual fossa
5. Labial bulge
6. Flattened root



(b) Deciduous Mandibular Right Lateral Incisor

1. Acute angle
2. Smooth curve
3. Obtuse angle
4. Crown rotated towards canine
5. Convex cingulum
6. Shallow lingual fossa
7. Circular root



Labial Lingual Mesial Distal
 Fig. 8 The deciduous lateral incisors. (a) Maxillary dimensions (mm): CH 5.6, RL 10.2, MDW 5.2, LLW 4.0. (b) Mandibular dimensions (mm): CH 5.2, RL 9.8, MDW 4.5, LLW 4.0.

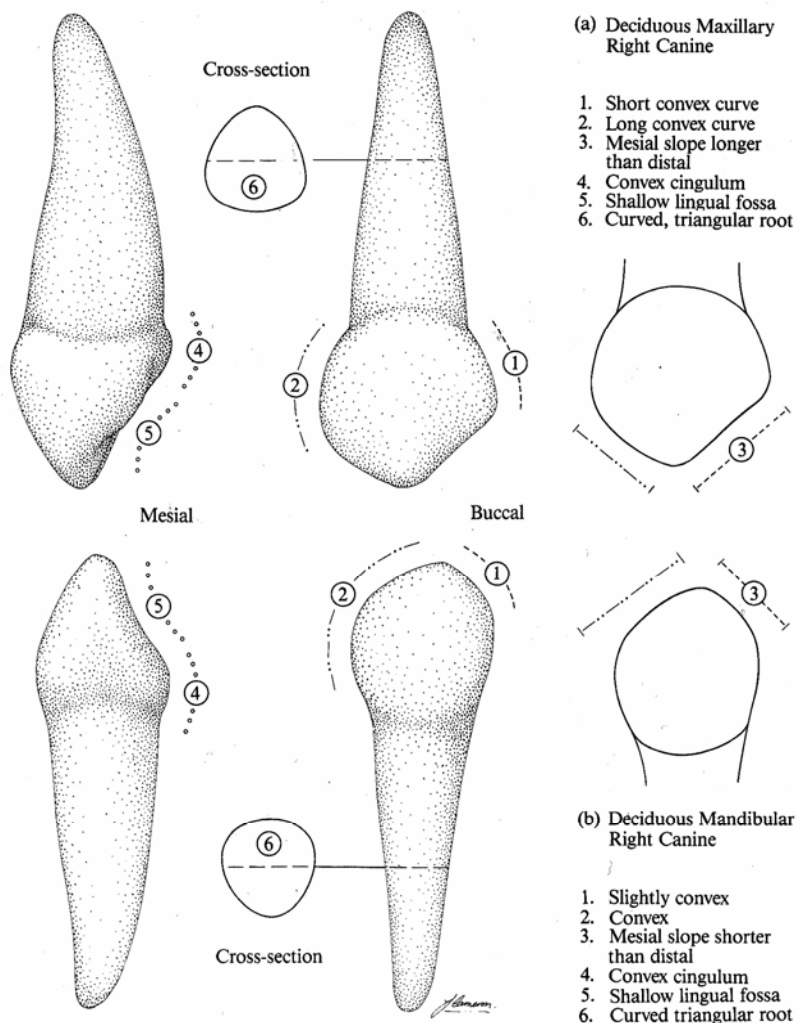


Fig. 9 The deciduous canines. (a) Maxillary dimensions (mm): CH 6.5, RL 13.0, MDW 6.8, BLW 7.0. (b) Mandibular dimensions (mm): CH 6.0, RL 11.2, MDW 5.5, BLW 4.9.

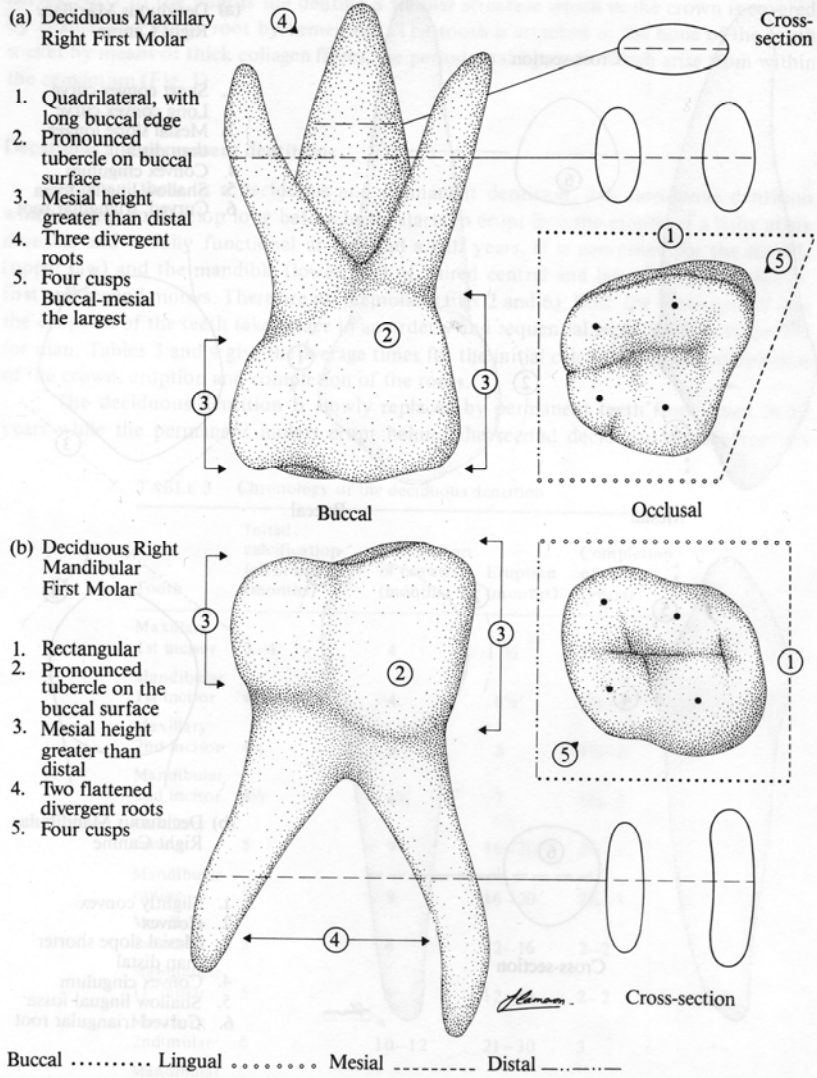


Fig. 10 The deciduous first molars. (a) Maxillary dimensions (mm): CH 5.1, RL 10.0, MDW 7.1, BLW 8.5. (b) Mandibular dimensions (mm): CH 6.0, RL 9.8, MDW 7.7, BLW 7.0.

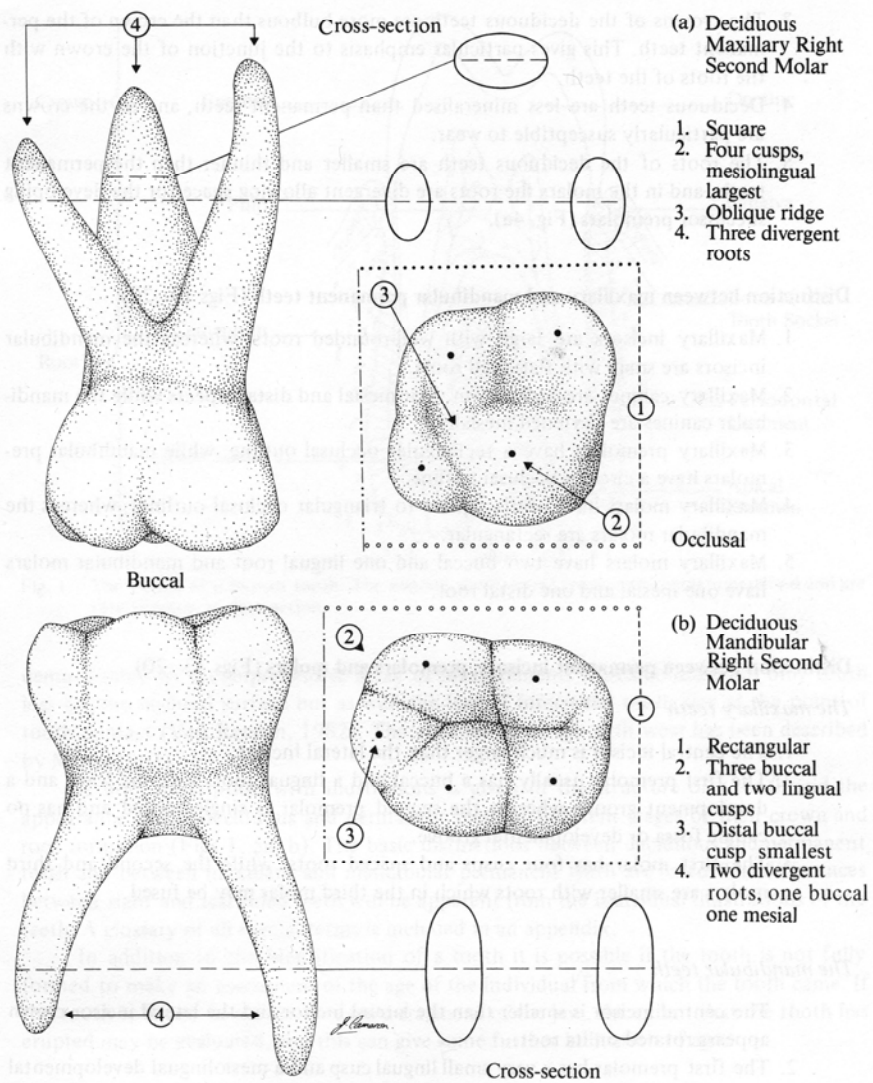


Fig. 11 The deciduous second molars. (a) Maxillary dimensions (mm): CH 5.7, RL 11.7, MDW 8.4, BLW 10.0. (b) Mandibular dimensions (mm): CH 5.5, RL 12.5, MDW 9.7, BLW 8.7.

3. The crowns of the deciduous teeth are more bulbous than the crown of the permanent teeth. This gives particular emphasis to the junction of the crown with the roots of the teeth.
4. Deciduous teeth are less mineralised than permanent teeth, and so the crowns are particularly susceptible to wear.
5. The roots of the deciduous teeth are smaller and thinner than the permanent teeth, and in the molars the roots are divergent allowing space for the developing successor premolars (Fig. 4a).

Distinction between maxillary and mandibular permanent teeth (Figs 13–20)

1. Maxillary incisors are large with well-rounded roots, whereas the mandibular incisors are small with flattened roots.
2. Maxillary canines are bulbous on their mesial and distal aspects while the mandibular canines are flattened mesially.
3. Maxillary premolars have a rectangular occlusal outline, while mandibular premolars have a circular occlusal outline.
4. Maxillary molars have nearly square to triangular occlusal outlines, whereas the mandibular molars are rectangular.
5. Maxillary molars have two buccal and one lingual root and mandibular molars have one mesial and one distal root.

Distinction between permanent incisors, premolars and molars (Figs 13–20)

The maxillary teeth

1. The central incisor is much larger than the lateral incisor.
2. The first premolar usually has a buccal and a lingual root, a canine fossa and a development groove whereas the second premolar is single rooted and has no canine fossa or developmental groove.
3. The first molar has four cusps and spaced roots, while the second and third molars are smaller with roots which in the third molar may be fused.

The mandibular teeth

1. The central incisor is smaller than the lateral incisor and the lateral incisor crown appears rotated on its root.
2. The first premolar has a very small lingual cusp and a mesiolingual developmental groove, while the second premolar has a lingual and buccal cusp of equal height.
3. The first molar has three buccal cusps and two lingual cusps; the second molar has four cusps while the third molar has a more irregular crown arrangement, and often the roots are fused.

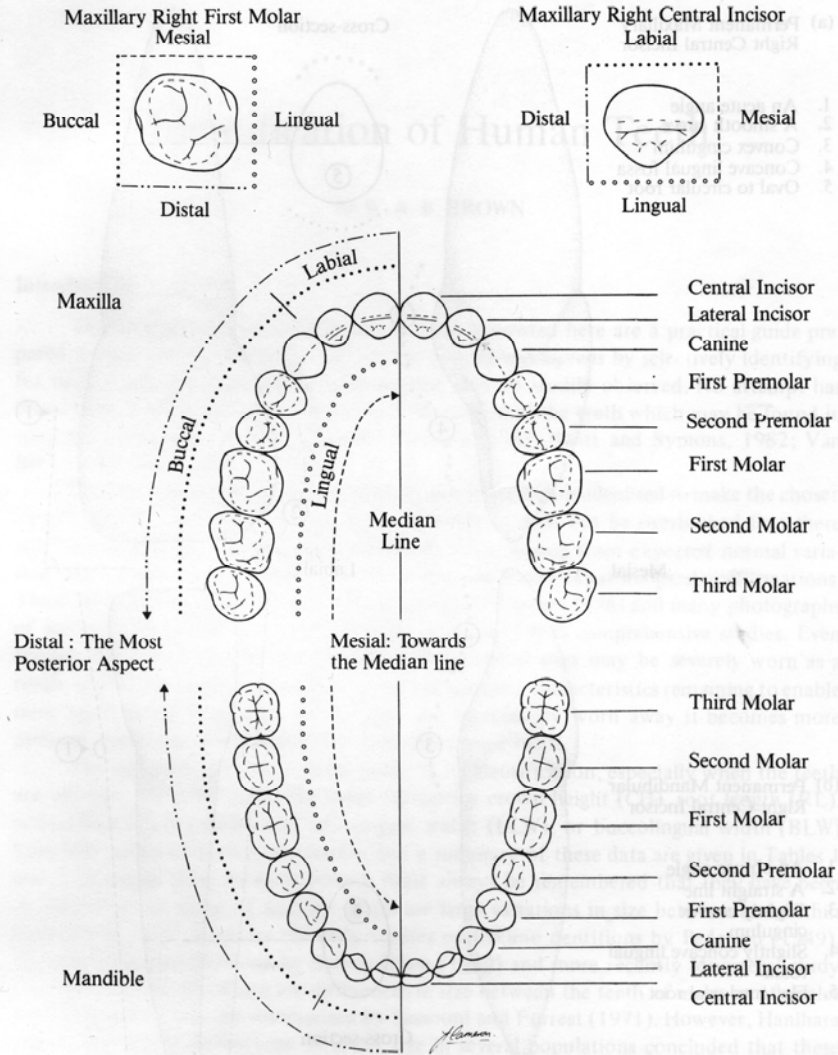
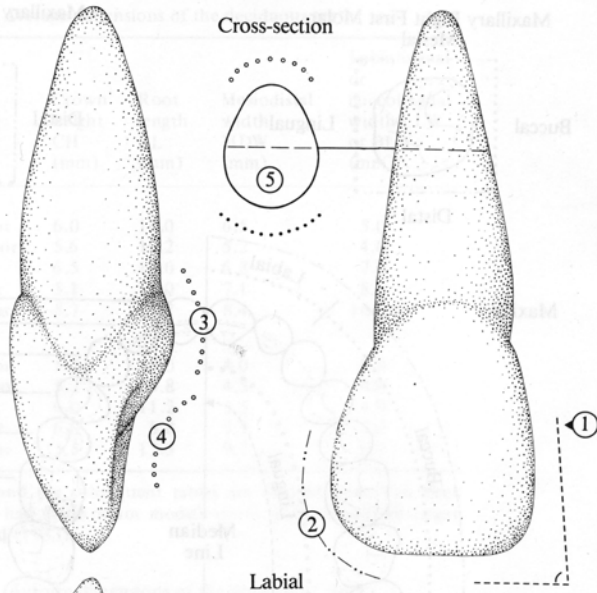


Fig. 12 The occlusal appearance of the permanent dentition. The varying line symbols are used for all the illustrations. Note that *labial* refers to the central and lateral incisors and *buccal* to the canines, premolars and molars.

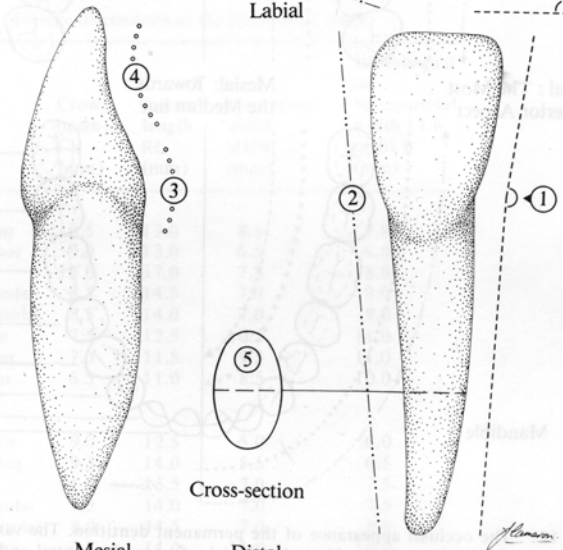
(a) Permanent Maxillary Right Central Incisor

1. An acute angle
2. A smooth curve
3. Convex cingulum
4. Concave lingual fossa
5. Oval to circular root



(b) Permanent Mandibular Right Central Incisor

1. An obtuse angle
2. A straight line
3. Slightly convex cingulum
4. Slightly concave lingual fossa
5. Flattened oval root



Labial Lingual Mesial Distal

Fig. 13 The permanent central incisors. (a) Maxillary dimensions (mm): CH 10.5, RL 13.0, MDW 8.5, LLW 7.0. (b) Mandibular dimensions (mm): CH 9.0, RL 12.5, MDW 5.0, LLW 6.0.

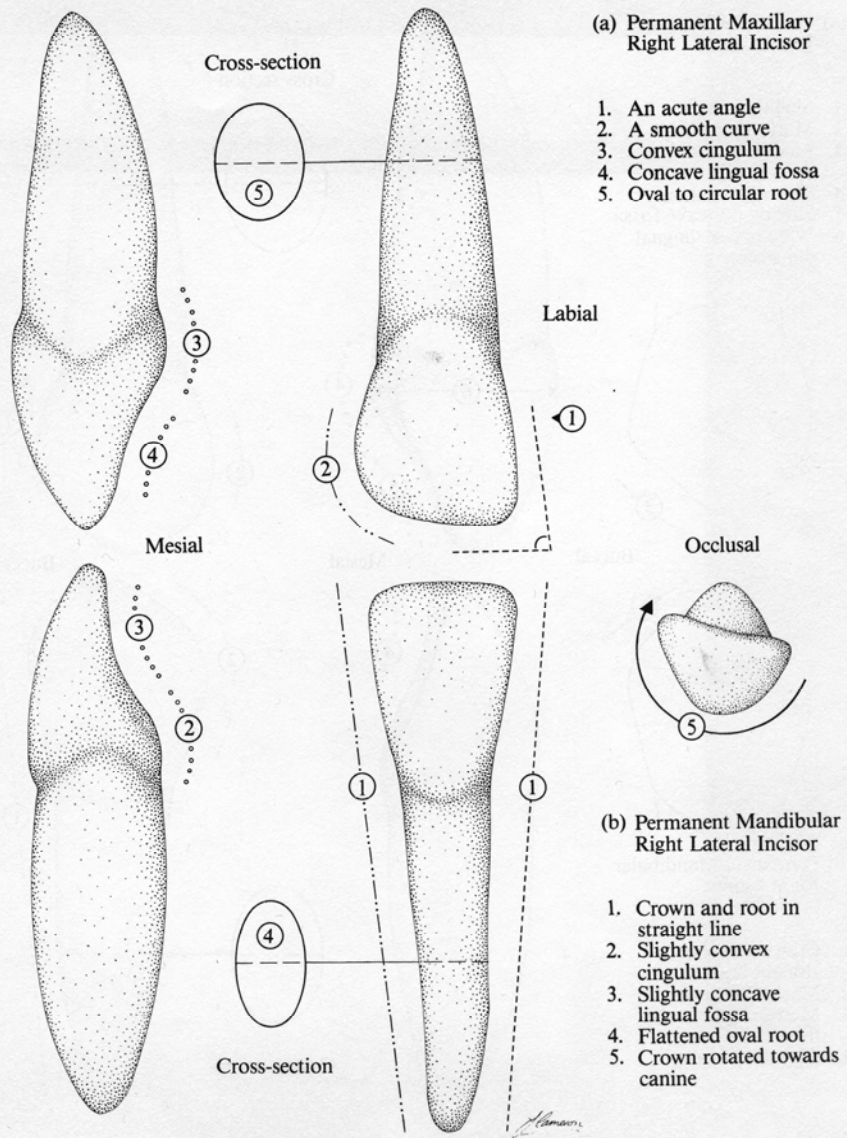
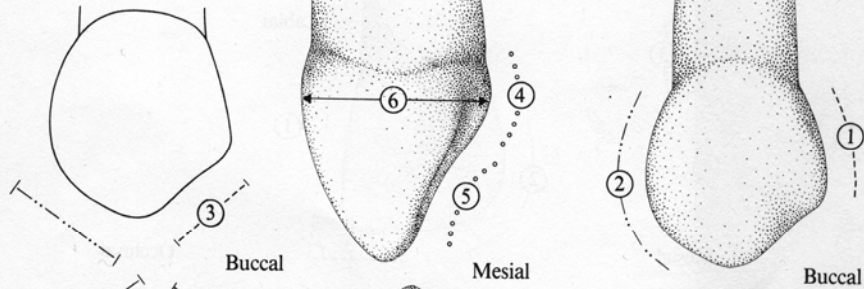


Fig. 14 The permanent lateral incisors. (a) Maxillary dimensions (mm): CH 9.0, RL 13.0, MDW 6.5, LLW 6.0. (b) Mandibular dimensions (mm): CH 9.5, RL 14.0, MDW 5.5, LLW 6.5.

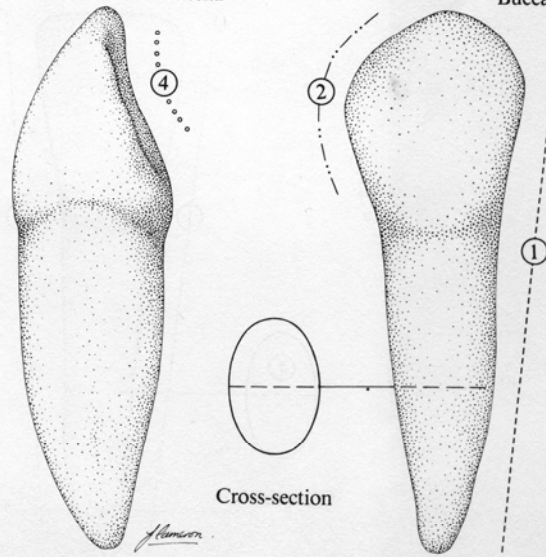
(a) Permanent Maxillary Right Canine

1. Slightly convex
2. Markedly convex
3. Mesial slope shorter than distal
4. Convex cingulum
5. Slightly concave fossa
6. Wide buccal/lingual dimensions



(b) Permanent Mandibular Right Canine

1. Crown and root in straight line
2. Markedly convex
3. Mesial slope shorter than distal
4. Slightly concave



Buccal Lingual Mesial Distal

Fig. 15 The permanent canines. (a) Maxillary dimensions (mm): CH 10.0, RL 17.0, MDW 7.5, BLW 8.0. (b) Mandibular dimensions (mm): CH 11.0, RL 15.5, MDW 7.0, BLW 7.5.

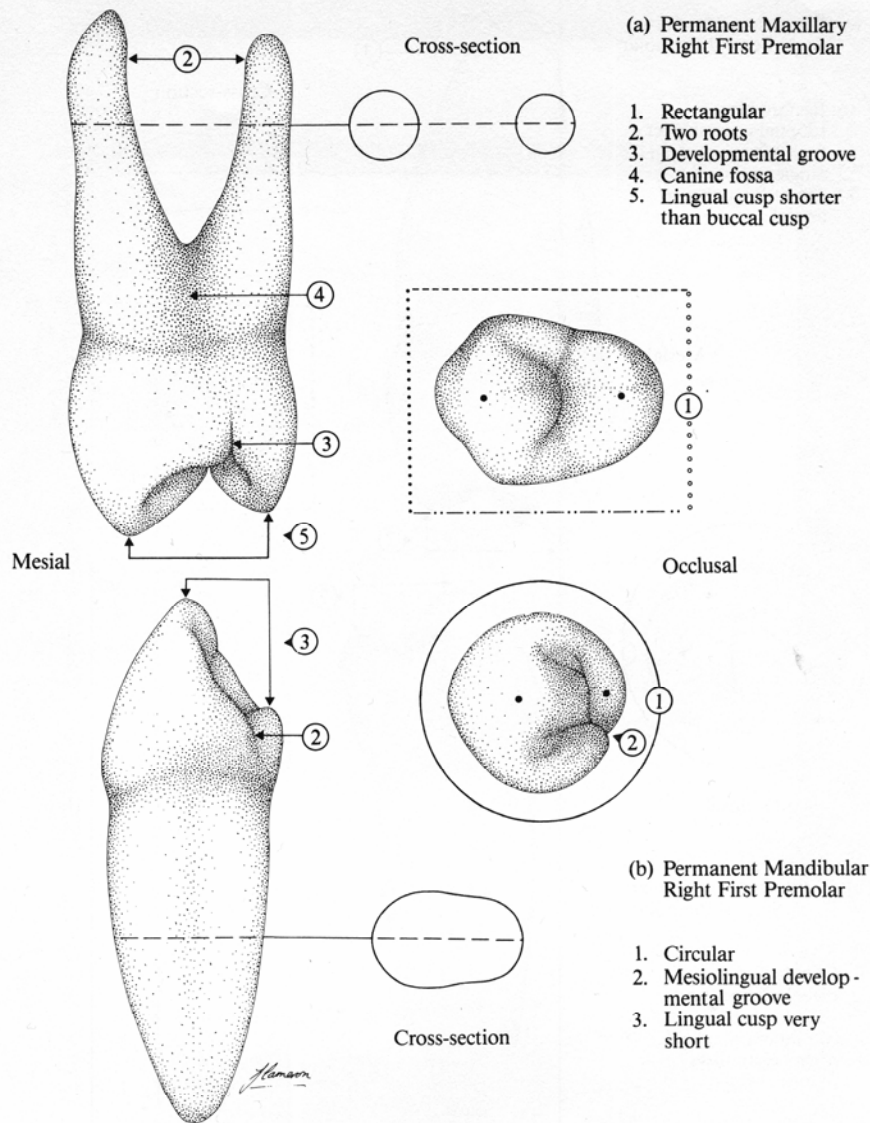
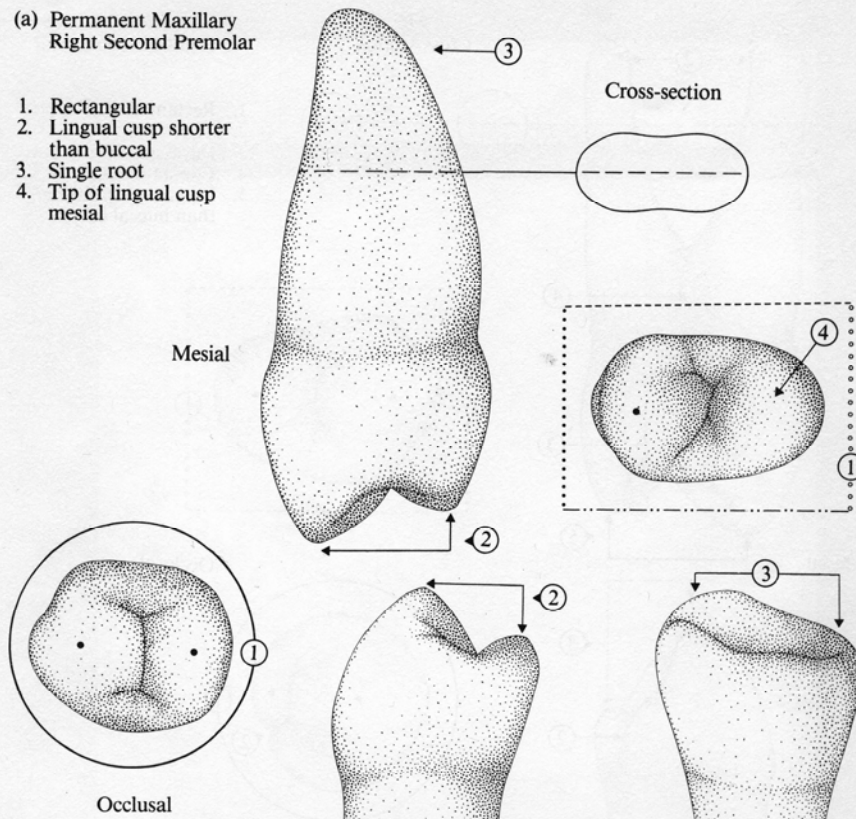


Fig. 16 The permanent first premolars. (a) Maxillary dimensions (mm): CH 8.5, RL 14.5, MDW 7.0, BLW 9.0. (b) Mandibular dimensions (mm): CH 8.5, RL 14.0, MDW 7.0, BLW 7.5.

(a) Permanent Maxillary Right Second Premolar

1. Rectangular
2. Lingual cusp shorter than buccal
3. Single root
4. Tip of lingual cusp mesial



(b) Permanent Mandibular Right Second Premolar

1. Circular
2. Lingual cusp shorter than buccal
3. Mesial marginal ridge higher than distal marginal ridge

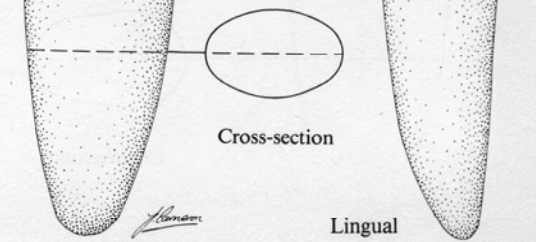


Fig. 17 The permanent second premolars. (a) Maxillary dimensions (mm): CH 8.5, RL 14.0, MDW 7.0, BLW 9.0. (b) Mandibular dimensions (mm): CH 8.0, RL 14.5, MDW 7.0, BLW 8.0.

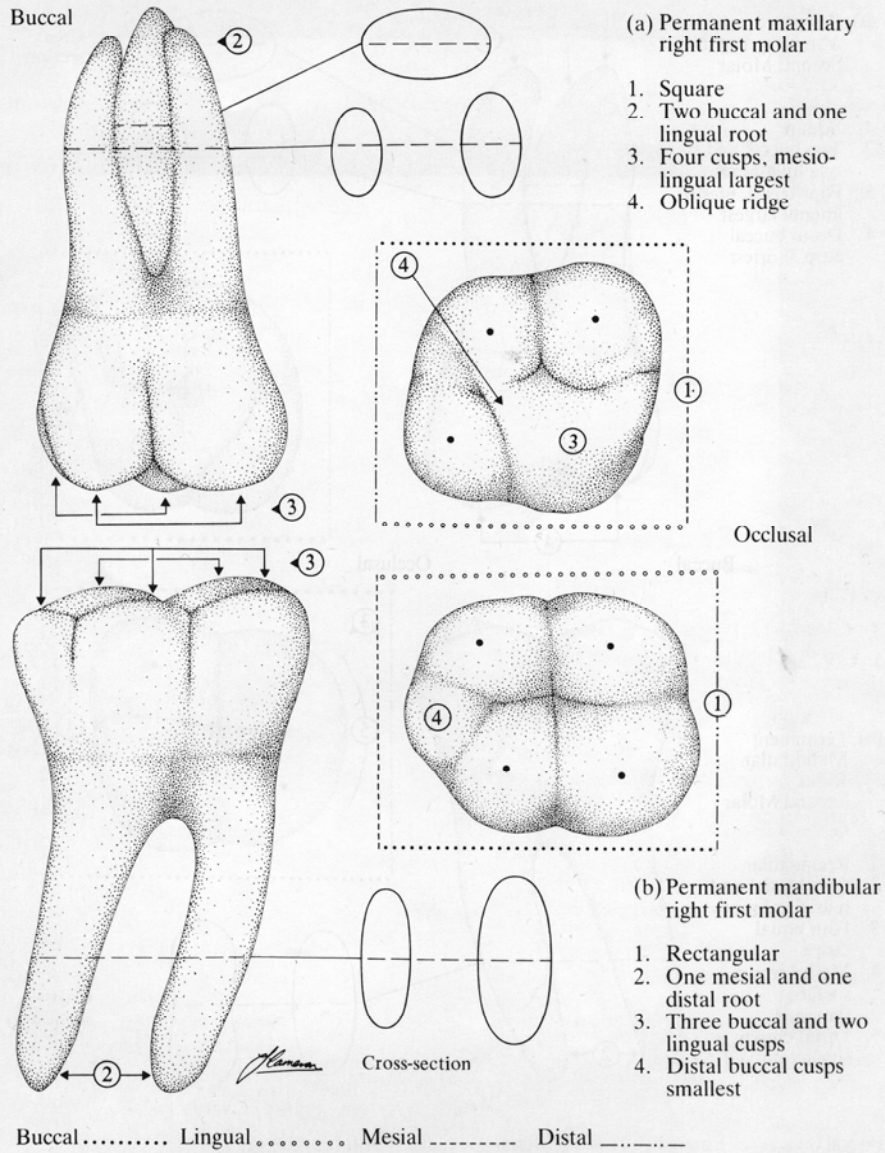
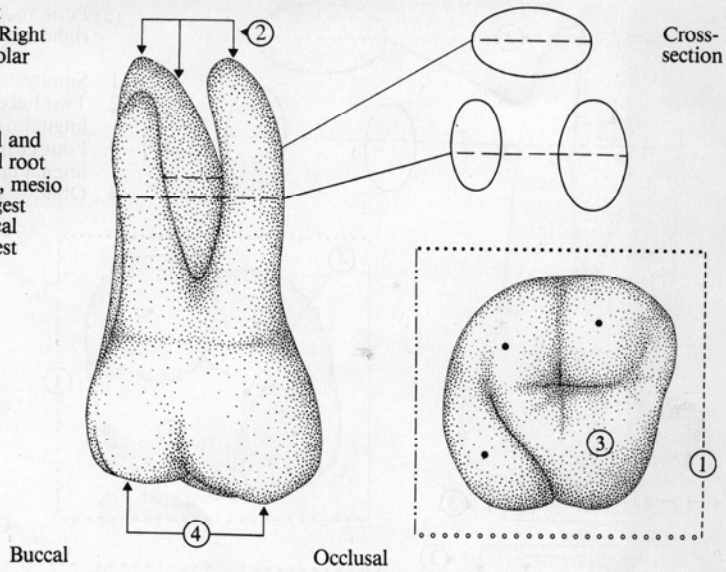


Fig. 18 The permanent first molars. (a) Maxillary dimensions (mm): CH 7.5, RL 12.5, MDW 10.5, BLW 11.0. (b) Mandibular dimensions (mm): CH 7.5, RL 14.0, MDW 11.0, BLW 10.0.

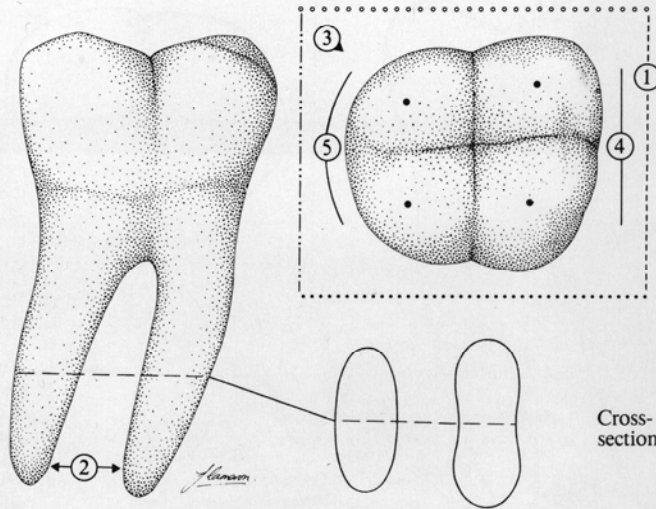
(a) Permanent Maxillary Right Second Molar

- 1. Square
- 2. Two buccal and one lingual root
- 3. Four cusps, mesio lingual largest
- 4. Distal buccal cusp shortest



(b) Permanent Mandibular Right Second Molar

- 1. Rectangular
- 2. One Mesial and one distal root
- 3. Four equal cusps
- 4. Mesial crown surface flattened
- 5. Distal crown surface curved



Buccal Lingual Mesial ----- Distal -----

Fig. 19 The permanent second molars. (a) Maxillary dimensions (mm): Ch 7.0, RL 11.5, MDW 9.5, BLW 11.0. (b) Mandibular dimensions (mm): CH 7.0, RL 12.0, MDW 10.5, BLW 10.0.

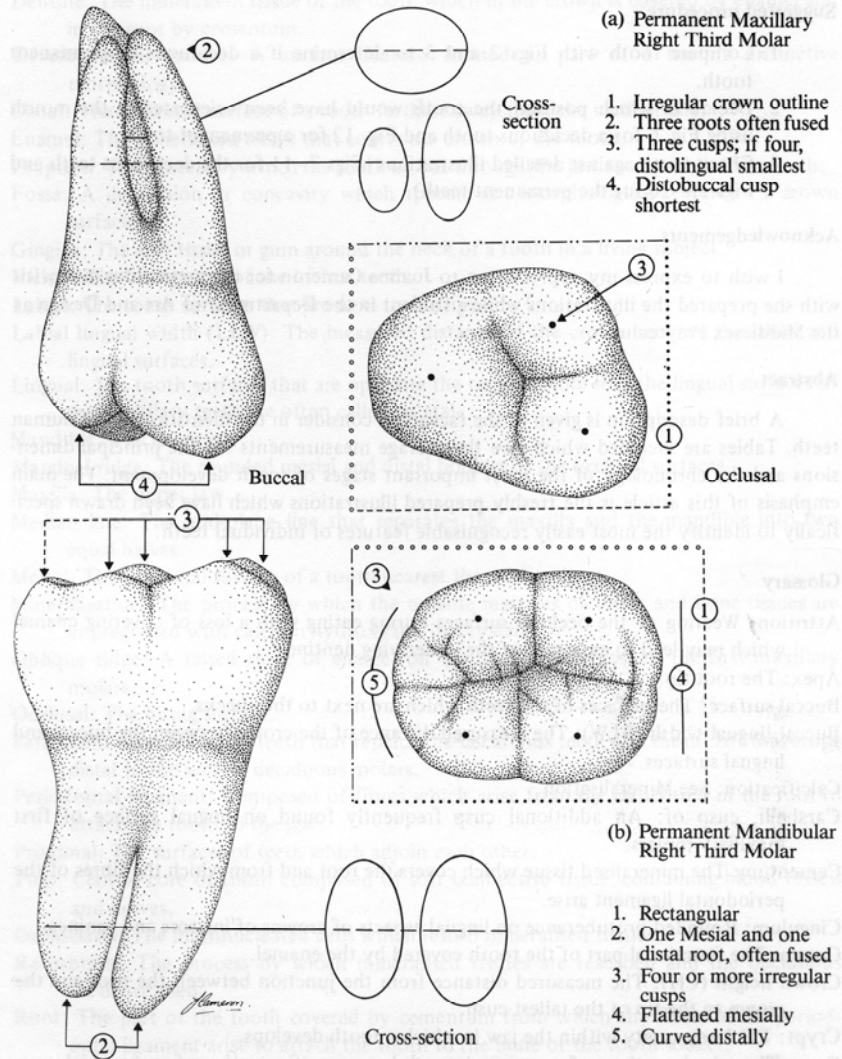


Fig. 20 The permanent third molars. (a) Maxillary dimensions (mm): CH 6.5, RL 11.0, MDW 8.5, BLW 10.0. (b) Mandibular dimensions (mm): CH 7.0, RL 11.0, MDW 10.0, BLW 9.5.

Suggested procedure

1. Compare tooth with Figs 2 and 3 to determine if a deciduous or permanent tooth.
2. Decide in which position the tooth would have been orientated in the mouth using Fig. 6 for a deciduous tooth and Fig. 12 for a permanent tooth.
3. Check tooth against detailed illustrations (Figs 7–11 for the deciduous teeth and Figs 13–20 for the permanent teeth).

Acknowledgements

I wish to express my appreciation to Joanna Cameron for the meticulous care with which she prepared the illustrations while a student in the Department of Art and Design at the Middlesex Polytechnic.

Abstract

A brief description is given of the factors to consider in the identification of human teeth. Tables are included which give the average measurements for the principal dimensions and the chronology of the most important stages of tooth development. The main emphasis of this article is the freshly prepared illustrations which have been drawn specifically to identify the most easily recognisable features of individual teeth.

Glossary

Attrition: Wearing of the occlusal surfaces during eating with a loss of covering enamel which may lead to exposure of the underlying dentine.

Apex: The root tip.

Buccal surface: The surfaces of the teeth which are next to the cheeks.

Buccal lingual width (BLW): The measured distance of the crown between the buccal and lingual surfaces.

Calcification: See Mineralisation.

Carabelli, cusp of: An additional cusp frequently found on lingual surface of first maxillary molars.

Cementum: The mineralised tissue which covers the root and from which the fibres of the periodontal ligament arise.

Cingulum: Rounded protuberance on lingual aspects of crowns of incisors and canines.

Crown: The functional part of the tooth covered by the enamel.

Crown height (CH): The measured distance from the junction between the root and the crown to the tip of the tallest cusp.

Crypt: The bony cavity within the jaw in which a tooth develops.

Cusp: The raised portions of a crown. A tooth has a specific number of cusps which vary consistently in size and are a useful aid to tooth identification.

Deciduous dentition: The first formed set of teeth which will be shed and replaced by permanent teeth.

- Dentine:** The mineralised tissue of the tooth which in the crown is covered by enamel and in the root by cementum.
- Developmental groove:** A surface feature formed as part of a tooth's distinctive morphology.
- Distal:** The proximal surface of a tooth farthest away from the median line.
- Enamel:** The mineralised tissue that covers the crown of the tooth.
- Eruption:** The process by which the tooth moves through the jaw to appear in the mouth.
- Fossa:** A depression or concavity which appears as a morphological feature of a crown surface.
- Gingiva:** The soft tissue or gum around the neck of a tooth in a living subject.
- Incisal:** The biting edge of the incisor teeth.
- Labial:** The tooth surfaces that are next to the lips.
- Labial lingual width (LLW):** The measured distance of the crown between the labial and lingual surfaces.
- Lingual:** The tooth surfaces that are opposite the tongue. Note that the lingual surfaces of the maxillary teeth are often called palatal.
- Mandible:** The lower jaw.
- Marginal ridge:** The rounded mesial and distal borders of the occlusal surfaces.
- Maxilla:** The upper jaw.
- Median line:** The mid-plane line that separates the maxilla and the mandible into two equal halves.
- Mesial:** The proximal surface of a tooth nearest the median line.
- Mineralisation:** The process by which the organic matrices of tooth and bone tissues are impregnated with calcium hydroxyapatite crystals.
- Oblique ridge:** A raised ridge of enamel on the occlusal surfaces of the first maxillary molars.
- Occlusal:** The biting surface.
- Permanent dentition:** The teeth that replace the deciduous teeth and the molars that erupt distal to the second deciduous molars.
- Periodontal ligament:** Composed of fibres which arise from the cementum of the root to attach the tooth to the jaw.
- Proximal:** The surfaces of teeth which adjoin each other.
- Pulp:** Central core of tooth composed of soft connective tissue, containing blood vessels and nerves.
- Osteoclasts:** The multinucleated cells which resorb mineralised tissues.
- Resorption:** The process by which mineralised tissues are resorbed and the deciduous teeth are shed.
- Root:** The part of the tooth covered by cementum from which the fibres of the periodontal ligament arise to attach the tooth to the bone of the tooth socket.
- Root length (RL):** The longest measurement from the junction of the root and crown to the apex of the root.
- Socket:** The bony part of the jaw in which the teeth are attached.

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