Louis Mackenzie

Tooth Anatomy: A Practical Guide Part 1: Drawing Posterior Teeth

Abstract: Understanding the anatomy of anterior and posterior teeth is important as the main aims of restorative dentistry are to restore the form, function and the aesthetics of damaged teeth. The anatomy of individual teeth is complex and infinitely variable, making it difficult to learn and challenging to teach. As tooth anatomy programs often occur in the early part of pre-clinical training it may also be difficult for clinical students to recall anatomical principles and apply them later to restorative treatment.
This paper is the first of two describing an innovative method of teaching and learning tooth anatomy that includes a program of step-by-step drawing exercises. The posterior tooth drawing exercises described here and the anterior versions in part two were originally designed for undergraduates studying tooth anatomy for the first time. Since their inception these exercises have also proved popular with experienced clinicians aiming to refine their dental anatomical knowledge for application in restorative procedures.
CPD/Clinical Relevance: Detailed understanding of tooth anatomy will help clinicians to plan, accurately and predictably, the restoration of posterior and anterior teeth.
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Most undergraduate curricula provide tooth anatomy teaching as a compulsory component of preclinical training.

Although anatomical complexity and variation make it a difficult subject to learn, most undergraduate programs aim to teach students basic shapes and predictable patterns so that they can recognize individual teeth and compare them to each other.

Often the teaching of tooth anatomy and clinical training are separated by months or even years, making it challenging for students to apply previously learned anatomical principles to restorative procedures.[1]

If tooth anatomy is not mastered during undergraduate training there is a risk that students may graduate with limited skills in the accurate shaping of direct restorations and in designing fixed and removable prosthodontic restorations so that they integrate functionally and aesthetically with the residual dentition.

In 2009, a review of the second year undergraduate curriculum at the University of Birmingham School of Dentistry provided the opportunity to redesign tooth anatomy teaching with a greater restorative focus. This paper is the first of a two-part series describing the innovative tooth drawing exercises that form an integral component of the program.

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Tooth anatomy teaching

Design of the new blended learning program included didactic teaching (predominantly online delivery) reinforced by a series of tooth drawing exercises divided into the following subject areas:
1. Posterior tooth anatomy (Figure 1);
2. Basic occlusion and endodontic anatomy (Figure 2) (not described in this paper);
3. Anterior tooth anatomy (described in paper 2).

The term *anatomy* is used in preference to the commonly used term *morphology*. *Morphology* has been described as the '*organized study of natural form and structure with no regard for function*'.[1] While the drawing exercises require students to draw individual teeth, it is emphasized that they function clinically as a single masticatory unit.[2]

The self-directed exercises are carried out independently over a one month period. Time taken for completion of the posterior tooth drawing exercises approximates to eight hours (~one hour per tooth) and uses the following protocol:
1. Students follow a series of online step-by-step guides;

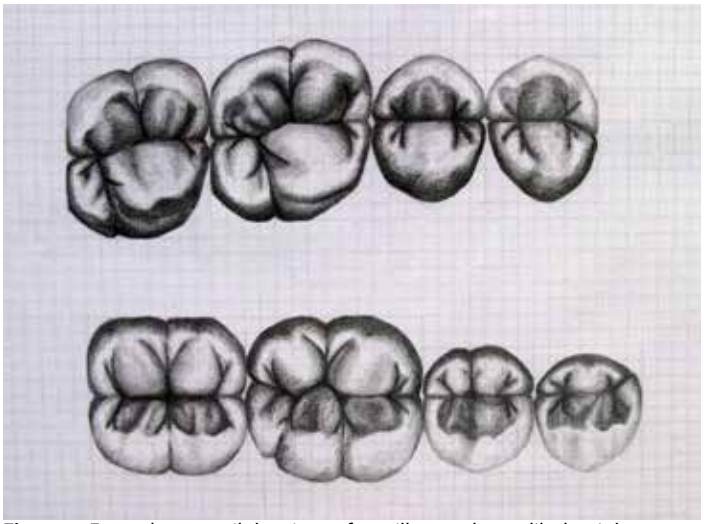

Figure 1. Exemplary pencil drawings of maxillary and mandibular right premolars and molars completed by a second year undergraduate student.

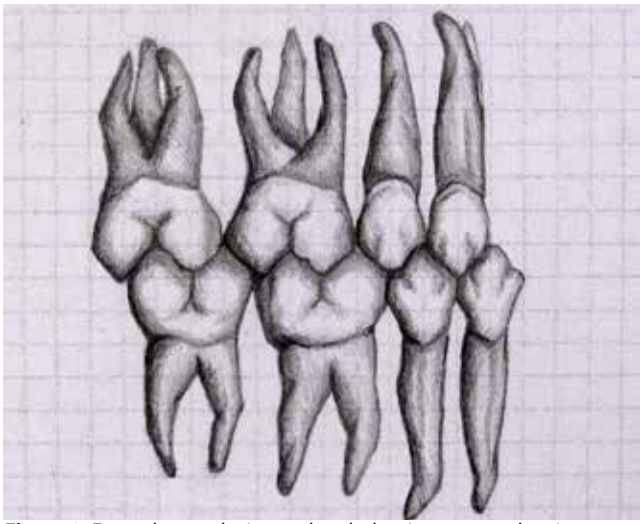

Figure 2. Exemplary occlusion and endodontic anatomy drawing exercises completed by a second year undergraduate student.

2. Students produce a portfolio of posterior (and anterior) tooth drawings;
3. Students submit hard copy originals for formative assessment and feedback.

The exercises aim to provide a foundation for subsequent practical studies that include: wax carving, composite shaping and amalgam carving simulation exercises, detailed study of occlusion and endodontics and clinical restorative procedures.

In common with a recent analogous programme in the USA,[3] the drawing exercises have produced positive student outcomes and feedback. As a result they have been adapted for Master's level training courses at both the University of Birmingham and at King's College London Dental Institute.

Tooth drawing exercise design

For decades it has been known that illustrations prove helpful in learning to reproduce the form and anatomical characteristics of natural teeth.[4] The tooth drawing exercises presented below were designed with reference to multiple sources including:

- Anatomical study guides for dental students and technicians;[1-12]
- Atlases of tooth size;[9,13]
- Wax carving guides designed to help students and technicians understand 3D anatomy;[14-17]
- Guidelines for anatomical amalgam carving;[17-20]
- Guidelines for shaping direct composite restorations;[20-23]
- Plastic teeth designed for simulation training, eg Kavo (Biberach, Germany), Frasaco (Tettnang, Germany) Nissin (Kyoto, Japan);
- Natural teeth (clinical photographs and extracted examples).

As some traditional learning resources have been described as 'laborious and unnecessarily detailed',[8] care was taken not to over-complicate the drawing designs and to interpret the salient features in simplified, stylized formats, rather than relying on the exact duplication of specific natural teeth.

The main aim of these drawing exercises is to instill fundamental anatomical principles so that they can be employed well beyond the academic identification of individual teeth. The step-by-step pencil marks were specifically chosen to correspond to the movements made clinically when reproducing functional occlusal anatomy with carving and shaping instruments. To reinforce the practical relevance further, the following design principles were also applied:

- The drawing exercises are of the permanent dentition, on which the majority of restorative procedures are carried out;
- 2D occlusal views representing the operator's clinical perspective were chosen, rather than more complicated 3D projections;
- Pencil drawing was recommended to enable corrections;
- The step-by-step designs use graph paper – making them suitable for students with a range of artistic talents;
- Teeth are drawn oversized but to scale (5.0 mm^2 graph paper representing 1.0 mm^2 clinically);
- To enable size comparison, teeth are drawn in boxes based on published proportions;[9,11]
- Individual teeth are drawn progressively in a logical order to reinforce common, repetitive anatomical forms (Table 1);
- Specific anatomical features are also drawn in stages, in the order shown in Table 2;
- The posterior teeth are drawn together, on one page, to enable comparison;
- Maxillary and mandibular teeth are drawn adjacently allowing students to begin considering occlusal relationships;
- Owing to the frequency of anatomical variations, third molar drawings were not included.

For expediency, only teeth from the right side of the mouth were initially selected, rather than full arches with contralateral mirror image drawings. This is a recognized disadvantage and the digital step-by-step guides presented for the first time in this series have been developed to allow students to practise both right and

1st	Mandibular right second molar
2nd	Mandibular right first molar
3rd	Maxillary right first molar
4th	Maxillary right second molar
5th	Maxillary right second premolar
6th	Maxillary right first premolar
7th	Mandibular right second premolar
8th	Mandibular right first premolar

Table 1. Recommended order for posterior tooth drawings.

1	Outline form
2	Cusp tips
3	Fissure pattern
4	Occlusal table
5	Cusp ridges
6	Marginal ridges
7	Dissectional grooves
8	Secondary anatomy

Table 2. Recommended stages for anatomical drawings.

left posterior tooth drawings (Figures 3 and 4).

The following step-by-step tooth drawing exercises may be used to learn and revise the common features making up the basic coronal anatomy of eight posterior teeth. The accompanying notes use nomenclature derived from the references listed above and the exercises are presented in the order recommended in Table 1.

Mandibular second permanent molars

The maxillary second permanent molars usually erupt between the ages of 12–13 years and are completely calcified by 15–16 years with two roots. They are the seventh tooth from the mandibular midline and are therefore commonly referred to as lower (right/left) 7 and abbreviated to LR7/LL7 or 47/37 in the Federation Dentaire International (FDI) system.[24]

Drawing the coronal anatomy of a mandibular second permanent molar

Mandibular second molars are usually the second largest mandibular teeth with average occlusal coronal dimensions of: 10.5 mm (mesiodistal) x 10 mm (buccolingual). Although they usually resemble the first permanent molars they tend to be smaller, squarer in shape and have fours cusps rather than five. The following guidelines may be used to draw a (slightly squarer than average) LR7 (Figure 5).

Figure 5a: Outline form

- Draw a 'rounded square' occlusal outline in a graph paper box measuring 10 x 10 squares;
- As the buccal surface is more rounded than the lingual, the buccal line angles are drawn as 3 x 3 curves and lingual line angles 2 x 2 curves.

Figure 5b: Cusp tips

- Lower 7 cusps are similar in size and divide the crown into four 'cusp blocks' of approximately equal size;
- The cusp tips are situated near the corners of the crown;
- The lingual cusps of lower second molars tend to be higher and slightly more pointed than the buccal cusps.

Figure 5c: Fissure pattern

- Lower second molars have three *occlusal*

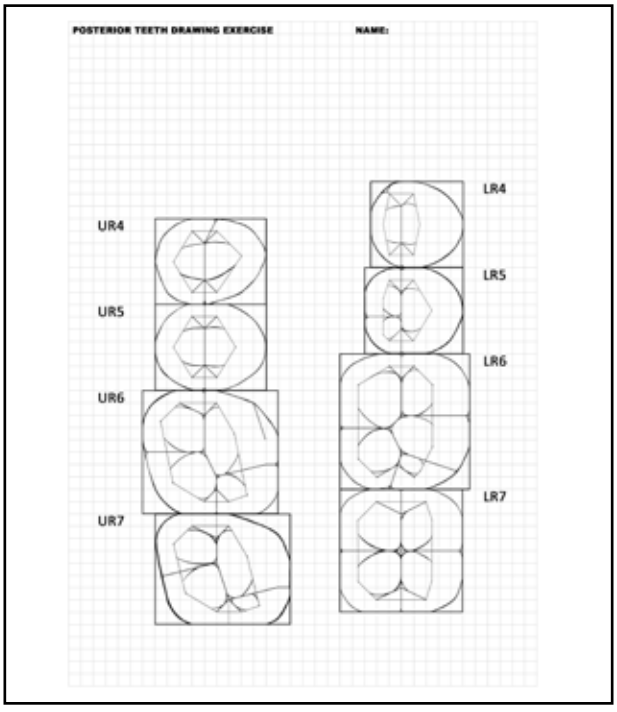

Figure 3. Digital drawing of the posterior tooth drawing exercises demonstrating outline forms, fissure patterns, occlusal tables and cusp ridges of right mandibular and maxillary teeth.

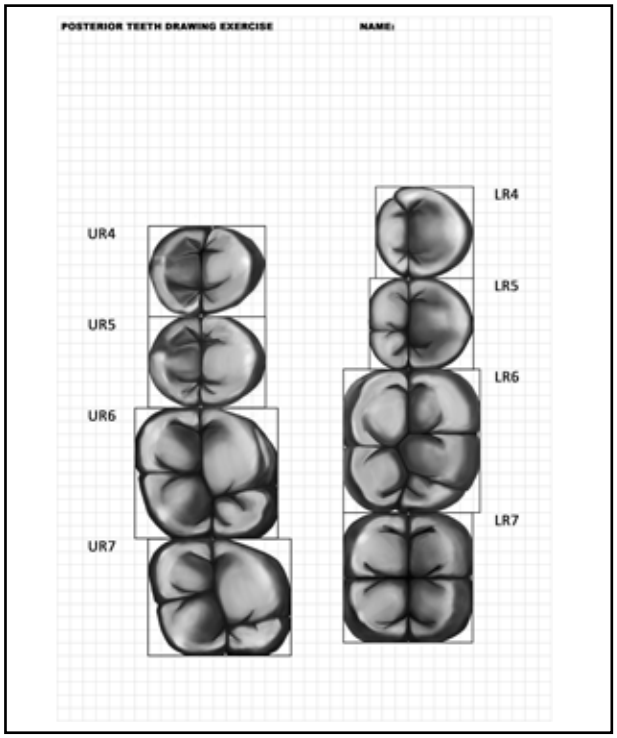

Figure 4. Digital rendering of right mandibular and maxillary posterior teeth.

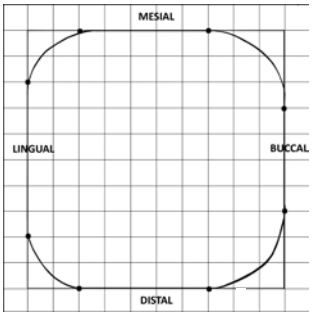

Figure 5a. 'Rounded oblong' outline form

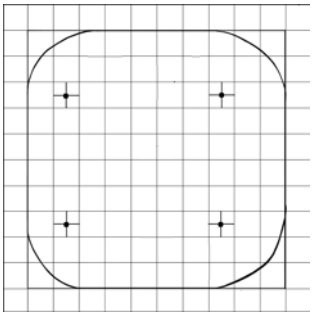

Figure 5b. Cusp tip positions

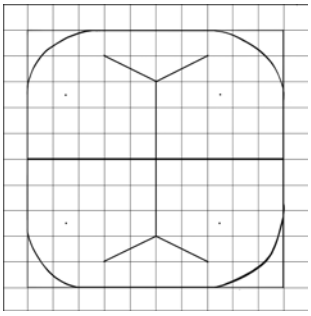

Figure 5c. Cruciform fissure pattern

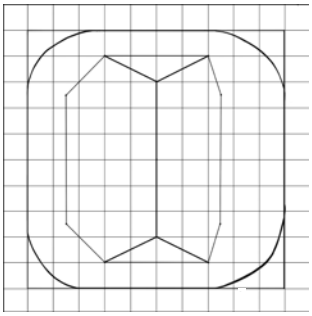

Figure 5d. Occlusal table *(drawn faintly)*

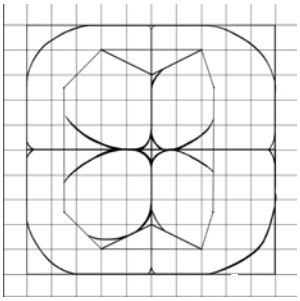

Figure 5e. Four oblique cusp ridges

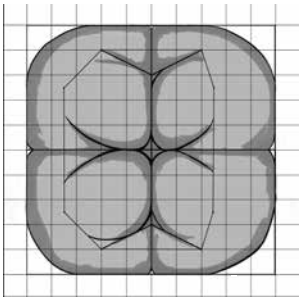

Figure 5f. Marginal ridges

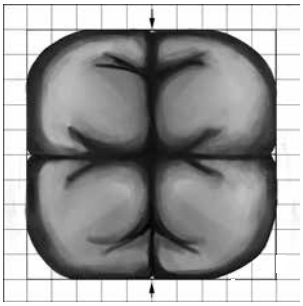

Figure 5g. Dissectional grooves

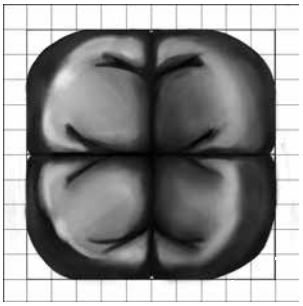

Figure 5h. LR7 Drawing complete

Figure 5. **(a–h)** Step-by-step tooth drawing exercise: mandibular second permanent molar.

fossae positioned centrally and mesially and distally inside the marginal ridges;

- Marginal fossae are generally triangular in shape and may be referred to as *triangular fossae*;
- The deepest part of each fossa is referred to as the *pit*;
- The midline fissure is the 'valley' between the bases of the lingual and buccal cusps and is an important anatomical landmark on virtually all posterior teeth;
- Lower second molars have two lateral fissures orientated perpendicularly to the midline fissure creating a cruciform (cross-shaped) fissure pattern (like a hot-cross bun!);
- Lateral fissures extend between the cusps of all lower molars onto the buccal and lingual axial surfaces. Here they become shallow *axial grooves* running parallel to the tooth's long axis;
- The buccal axial groove may extend into a pit known as the *Foramen caecum molarum*;
- The primary cruciform fissure pattern is supplemented by *short marginal fissures* extending from the mesial and distal pits.

Figure 5d: Occlusal table

- The outline of the occlusal table is not always obvious clinically and should be drawn faintly so that it may be erased later.

Figure 5e: Cusp ridges

- The cusp ridges originate from the cusp tips and are angled toward the centre of the tooth at approximately 45 degrees to the midline;
- The shape of cusp ridges has been variously described as: teardrop- or egg-shaped or as triangular lobes;
- Drawing the four cusps is difficult. It is recommended to draw the general shape initially as 'rounded balloons' tapering from the cusp tips to form mesiolingual (ML), mesiobuccal (MB), distolingual (DL) and distobuccal (DB) cusp ridges.

Figure 5f: Marginal ridges

- Marginal ridges may be a single ridge of enamel, but are more commonly made up of two parts: one lingual and one buccal, separated by a shallow groove.

Figure 5g: Dissectional grooves

- The shallow marginal grooves are extensions of the midline fissure and together they form the *dissectional groove*, which is a common feature of all mandibular and maxillary posterior teeth;
- Where the dissectional and axial grooves meet the tooth outline the angles should be rounded.

Figure 5h: LR7 drawing complete

- When rendering the drawing to demonstrate its 3D anatomy start by darkening the three most important coronal features: the outline form, the cusps, the fissure pattern (midline fissure/lateral fissures/marginal fissures and the axial grooves);
- The buccal (functional) cusps should appear more rounded than the lingual cusps;
- The outline form, cusp ridges and triangular fossae (inside the marginal ridges) may then be shaded to complete the drawing.

Mandibular first permanent molars

The mandibular first permanent molars usually erupt between the ages of 6–7 years and are completely calcified by 9–10 years with two roots. They are the sixth tooth from the mandibular midline and are therefore commonly referred to as lower

(right/left) 6 and abbreviated to LR6/LL6 or 46/36 (FDI).

Drawing the coronal anatomy of a mandibular first permanent molar

Lower first molars are usually the largest mandibular teeth with average occlusal coronal dimensions of 11 mm (mesiodistal) x 10.5 mm (buccolingual). Like the second permanent molars they are generally oblong in shape, but are more rectangular and have five cusps rather than four. The following guidelines may be used to draw a LR6 (Figure 6).

Figure 6a: Outline form

- Draw the occlusal outline as shown in a graph paper box measuring 11 x 10.5 squares;
- The buccal surface is more rounded than the lingual which is often very flat.

Figure 6b: Five cusp tips

- Lower first molars have two lingual cusps which are similar in size;
- They have three buccal cusps: mesiobuccal, centrobuccal and a small distobuccal cusp, which is known as the *Hypoconulus*;
- Like the lower second molars, the lingual cusps tend to be higher and more pointed;
- Like all lower posterior teeth, the buccal cusp tips are closer to the midline and more rounded;
- The buccal cusps accept most of the occlusal load from the opposing teeth and are known as the *functional cusps*.

Figure 6c: Dryopithecus fissure pattern

- The lower first molars have three occlusal fossae positioned mesially, distally and centrally;
- The central fossa anatomy varies and often consists of 1–3 pits;
- 90% of lower first molars share the unique *Dryopithecus* morphology;[6,7]
- *Dryopithecus* morphology is defined as a five-cusped tooth with bases of disto- and mesio-lingual and centro-buccal cusps meeting at the central fossa;[8]
- In common with all lower molars and premolars, the midline fissure is positioned slightly lingually and the curved buccal cusps predominate;
- The lingual lateral fissure and the more mesially placed of the buccal lateral fissures are parallel but are slightly offset, unlike the cruciform fissure pattern of lower second molars.

Figure 6d: Occlusal table

- Draw the outline of the occlusal table faintly as it will be erased later.

Figure 6e: Cusp ridges

- Each of the five molar cusps has an oblique cusp ridge extending from the cusp tip towards the centre of the tooth at approximately 45 degrees to the midline;
- Average cusp sizes decrease in the following order: mesio-lingual, disto-lingual, mesio-buccal, centro-buccal, disto-buccal.

Figure 6f: Dissectional grooves

- The mesial marginal ridge is often broken by a shallow fissure. This is a continuation of the midline dissectional groove;
- The dissectional groove commonly extends more deeply across the distal marginal ridge and may extend onto the distal axial surface;
- The distal marginal fissures may be small or absent.

Figure 6g: 3D anatomy

- The buccal lateral fissures and axial grooves divide the buccal surface into three distinct lobes;
- Buccal pits (*Foramen caecum molarum*) are present in 60% of lower first molars;[9]
- The lingual axial groove is often poorly

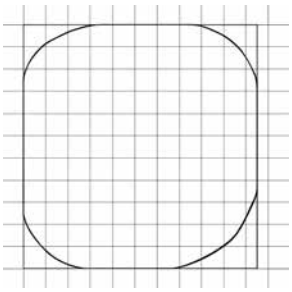

Figure 6a. Outline form

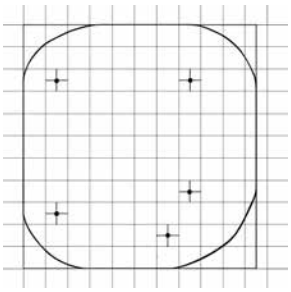

Figure 6b. Five cusp tips

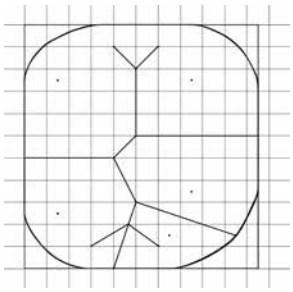

Figure 6c. *Dryopithicus* fissure pattern

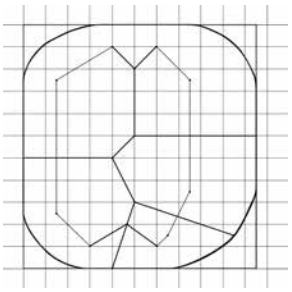

Figure 6d. Occlusal table *(drawn faintly)*

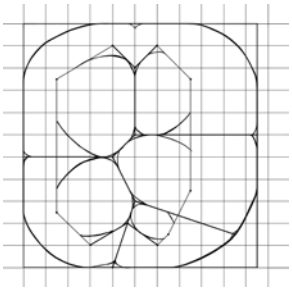

Figure 6e. Five cusp ridges

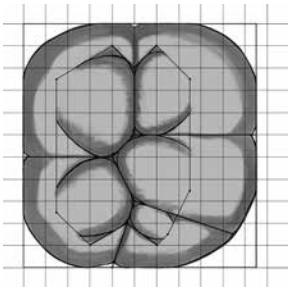

Figure 6f. Dissectional grooves

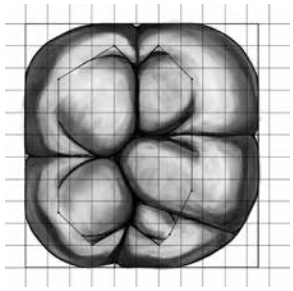

Figure 6g. 3D occlusal anatomy

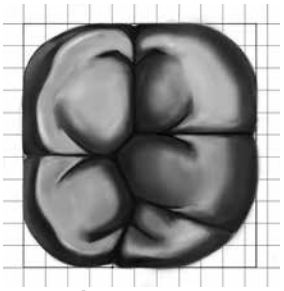

Figure 6h. LR6 Drawing complete

Figure 6. Step-by-step tooth drawing exercise: mandibular first permanent molar.

developed in comparison,

Figure 6h: LR6 drawing complete

- Render the drawing to emphasize the most important occlusal anatomical features.

Maxillary first and second permanent molars

Maxillary first and second molars usually erupt between the ages of 6–7 and 12–13 years, respectively, and are completely calcified by ages 9–10 and 15–16 years, both with three roots. They are the sixth and seventh teeth from the maxillary midline and are therefore commonly referred to as upper (right/left) 6/7 and abbreviated to UR6/7 and UL6/7 or 16/17 and 26/27 (FDI).

Drawing the coronal anatomy of maxillary first and second permanent molars

Upper first and second molars are usually the largest and second largest maxillary teeth with average occlusal coronal dimensions of 10 (mesio-distal) x 11 (bucco-palatal) squares and 9 (mesio-distal) x 11 (bucco-palatal) squares, respectively. Upper first and second molars have very similar anatomy and are therefore considered here together. The following guidelines may be used to draw UR6 and then UR7 (Figure 7).

Figures 7a and 7i: outline form and cusp tips

- The occlusal shape of upper molars resembles a *rhombus*;
- Upper molars have four cusp tips situated at the corners of the rhombic outline;
- Upper first molars commonly (50–70% of patients) have a fifth cusp extending from the mesiopalatal cusp. It is known as the *cusp of Carabelli*.

Figures 7b and 7i: Basic fissure pattern

- Upper molars have three occlusal fossae: mesial, central and distal;
- The distal fossa is often supplemented with an additional pit;
- The primary fissure pattern of upper 6s and 7s is often very similar and can

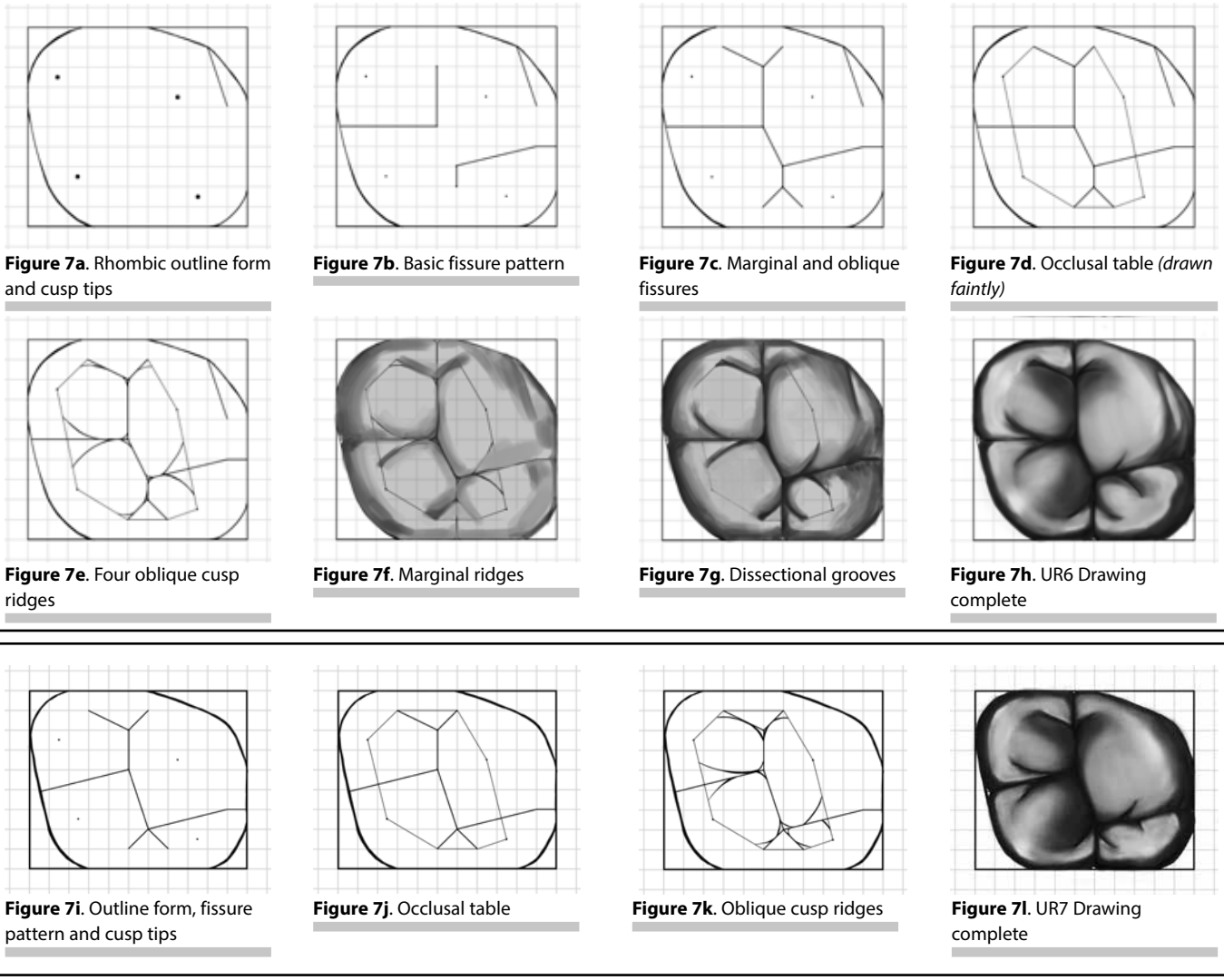

Figure 7a. Rhombic outline form and cusp tips

Figure 7b. Basic fissure pattern

Figure 7c. Marginal and oblique fissures

Figure 7d. Occlusal table *(drawn faintly)*

Figure 7e. Four oblique cusp ridges

Figure 7f. Marginal ridges

Figure 7g. Dissectional grooves

Figure 7h. UR6 Drawing complete

Figure 7i. Outline form, fissure pattern and cusp tips

Figure 7j. Occlusal table

Figure 7k. Oblique cusp ridges

Figure 7l. UR7 Drawing complete

Figure 7. **(a–h)** Maxillary first permanent molar UR6. **(i–l)** Maxillary second permanent molar UR7.

be simplified by drawing two 'L' shapes as shown;
- The buccal lateral fissure of upper second molars may be orientated more distally.

Figures 7c and 7i: Fissure pattern
- The two 'L'-shaped fissures are joined by a (shallow) central fissure and are supplemented by short marginal fissures mesially and distally;
- The disto-palatal fissure usually extends as a palatal axial groove, which commonly terminates in a palatal pit.

Figures 7d and 7j: Occlusal table
- Draw the occlusal table faintly as it will be erased later.

Figures 7e and 7k: Cusp ridges
- Both upper and lower molar cusp ridges are known as *oblique ridges* as they are angled at approximately 45 degrees to the tooth midline and are orientated towards the centre of the tooth;
- The relative cusp sizes of upper molars are distinctive features;
- Upper molars have two buccal cusps of similar size;
- They have one large mesio-palatal cusp and one small disto-palatal cusp (known as the *Hypoconus*)

Figure 7f: Marginal ridges
- Render the triangular fossae inside the mesial and distal marginal ridges.

Figure 7g: Dissectional grooves
- The midline fissure commonly extends across the distal marginal ridge as a well-defined dissectional groove, but the mesial version is sometimes absent.
- Upper first, second and third molars diminish in size on moving distally and tend to become more triangular in shape due mainly to decrease in *Hypoconus* size

Figures 7h and 7l: UR6 and UR7 drawings complete
- Render the drawings using the same techniques as described for the lower molar drawings;
- Upper first molars may be distinguished by a prominent oblique ridge joining mesio-palatal and disto-buccal cusps. It is known as the *Crista obliqua*

Maxillary permanent premolars

The maxillary first and second premolars usually erupt between the ages of 10–11 and 10–12 years, respectively. Upper first premolars are completely calcified by 13–14 years and usually have two roots (which may be fused). Upper second premolars are calcified by 13–15 years and usually have one root. They are the fourth and fifth teeth from the maxillary midline and are therefore commonly referred to as upper (right/left) 4/5 and abbreviated to UR4/5 and UL4/5 or 14/15 and 24/25 (FDI).

Drawing the coronal anatomy of maxillary first and second permanent premolars

Upper first and second premolars are usually very similar in size and shape and may both be drawn inside boxes with dimensions of 7 (mesio-distal) x 9 (bucco-palatal) squares. As upper first and second premolars have very similar anatomy they are considered together here.

Upper premolars are commonly extracted to make space for orthodontic tooth movement and when visually assessing new patients it can be challenging to determine which premolar remains. Use the following guidelines to draw UR5 and then UR4 and learn the subtle variations in their occlusal coronal anatomy (Figure 8).

Figures 8a and 8i: Outline form
- The occlusal outline of upper premolars may be described as *oval* or *egg-shaped*;
- While upper second resemble upper first premolars in many ways, they are usually more rounded and more symmetrical.

Figures 8b and 8i: Cusp tips
- Upper premolars have two cusps;
- The buccal cusps are usually bigger than the palatal cusps and the occlusal outline form usually tapers palatally;
- Upper second premolars have cusp tips of similar height compared to upper first premolars which usually have higher (and sharper) buccal cusps;
- Upper first premolars are not as symmetrical as upper second premolars because their palatal cusp tip tends to be orientated mesially.

Figures 8c and 8i: Fissure pattern
- Upper premolars have two fossae (mesial and distal) separated by *transverse cusp ridges*;
- The primary fissure pattern of upper premolars is relatively simple and is described as *H-form*;
- The upper first premolar tends to have a deeper midline fissure.

Figures 8d and 8i: Occlusal table
- Draw the occlusal table faintly as it will be erased later.

Figures 8e and 8j: Cusp ridges
- Unlike the oblique cusp ridges of molars the cusp ridges of upper premolars are approximately perpendicular to the tooth midline and are known as *transverse ridges*.

Figure 8f Marginal ridges
- Render the triangular marginal fossae inside the mesial and distal marginal ridges.

Figures 8g and 8k: Dissectional grooves and secondary fissures
- On upper second premolars the dissectional grooves crossing the marginal ridges are often poorly defined or absent;
- A characteristic feature of upper first premolars is that the midline fissure often interrupts the mesial marginal ridge as a dissectional groove, which tends to be orientated palatally;
- The mesial dissectional groove may extend onto the mesial proximal surface as a concavity. This unique anatomical feature is known as the *canine groove* (or *fossa*);
- Premolars often have secondary ridges formed between the transverse ridges and the triangular marginal fossae;
- Draw four secondary cusp ridges between the transverse ridges and the triangular fossae.

Figures 8h and 8l: UR5 and UR4 drawings complete
- Render the upper premolar drawings to demonstrate the subtle variations between upper first and second premolar anatomy.

Mandibular permanent premolars

Mandibular first and second premolars usually erupt between the ages of 10–12 and 11–12 years and are completely calcified by 13–15 and 14–15 years, respectively, with one root each. They are the fourth and fifth teeth from the mandibular midline and are therefore commonly referred to as lower (right/left) 4/5 and abbreviated to LR4/5 and LL4/5 and 44/45 & 34/35 (FDI).

Drawing the coronal anatomy of mandibular first and second permanent premolars

Unlike the upper premolars,

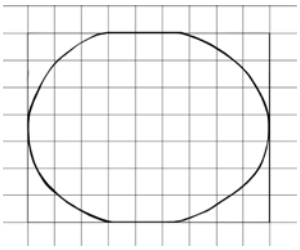

Figure 8a. Egg-shaped outline form

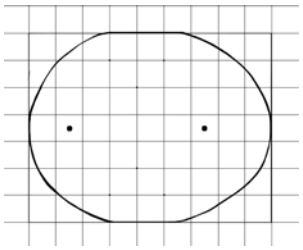

Figure 8b. Cusp tips

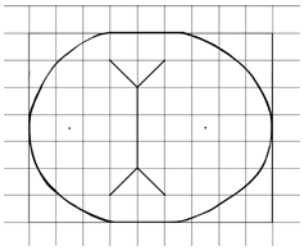

Figure 8c. H-form fissure pattern

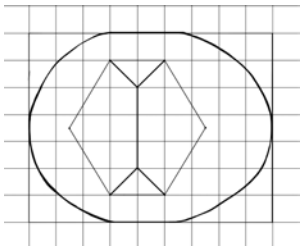

Figure 8d. Occlusal table (*drawn faintly*)

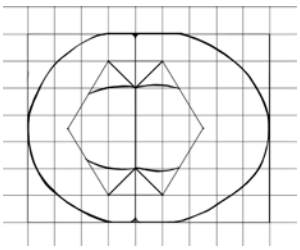

Figure 8e. Two transverse cusp ridges

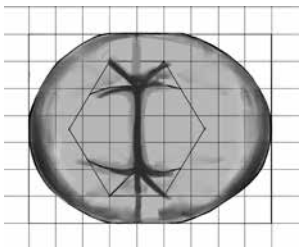

Figure 8f. Marginal ridges

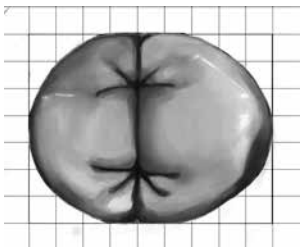

Figure 8g. Dissectional grooves and secondary fissures

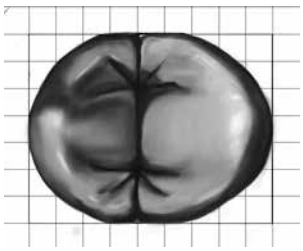

Figure 8h. UR5 Drawing complete

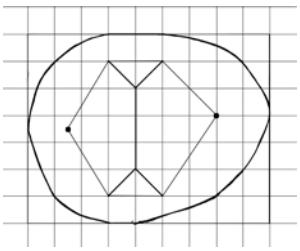

Figure 8i. Outline form, cusp tips, fissure pattern, occlusal table

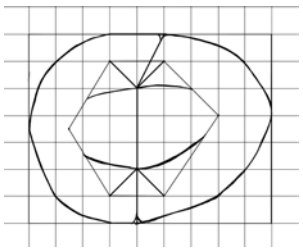

Figure 8j. Two transverse cusp ridges

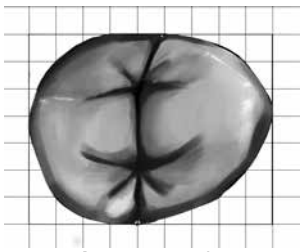

Figure 8k. Dissectional grooves and secondary fissures

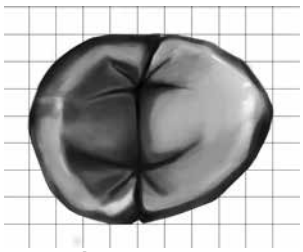

Figure 8l. UR4 Drawing complete

Figure 8. **(a–h)** Upper right second permanent premolar UR5. **(i–l)** Upper right first permanent premolar UR4.

which are similar, the lower first and second premolars have distinct anatomical differences. The average lower second premolar may be drawn inside a box with dimensions of 7 (mesiodistal) x 8 (buccolingual) squares and the lower first premolar 7 (mesio-distal) x 7.5 (bucco-lingual) squares. The following guidelines may be used to draw LR5 and then LR4 (Figure 9).

Figures 9a and 9i: Outline form

- Lower second premolars are larger than lower first premolars;
- Lower second premolars have a squarer occlusal outline than all the other premolars;
- The general occlusal outline of lower first premolars is *circular*;
- Lower premolars all have marked buccal curvatures to accommodate the occluding upper premolars;
- Unlike the more symmetrical upper premolars, the lower first and second lower premolars have much smaller lingual cusps compared to their buccal cusps, which make up the bulk of their crowns.

Figures 9b and 9i: Cusp tips

- Lower first premolars have two cusps, compared to lower second premolars, which commonly have three;
- Lower second premolars have variable cusp morphology. They may have two or three cusps;
- The three-cusped version is most common and comprises one buccal cusp and two lingual cusps. The mesiolingual cusp tip is usually larger than the disto-lingual
- In the two-cusped version the lingual cusp is often mesially placed;
- Lower second premolars have a more rounded and shorter buccal cusp than lower first premolars.

Figures 9c and 9i: Fissure pattern

- The occlusal surface of lower first premolars has two fossae (mesial and distal). The distal fossa is usually larger;
- Three-cusped lower second premolars have three fossae (mesial, central and distal);
- The fissure pattern of lower premolars is lingually placed and the midline fissure often curves around the lingual aspect of the buccal cusp;
- Three-cusped lower second premolars are said to have a *Y-form* fissure pattern

compared to the *H-form* fissure pattern that is common to all the other premolars.

Figures 9d and 9j: Occlusal table

■ In lower first premolars the buccal cusp tip is close to the middle of the tooth and the occlusal surface slopes lingually at approximately 45 degrees to a diminutive lingual cusp, which may not occlude with the upper teeth.

Figures 9e and 9k: Cusp ridges and fossae

■ On lower first premolars the fossae and transverse ridges are the dominant occlusal features. Fissures may be poorly developed or even absent;

■ The (*Y-form*) lower second premolar is the only posterior tooth to have cusp features common to both a premolar and a molar. The buccal aspect, in common with the other premolars, has a single transverse cusp ridge but the lingual aspect resembles a molar with two oblique cusp ridges.

Figures 9f and 9k: Marginal ridges

■ The lower first premolar has well-defined mesial and distal marginal ridges that enclose the mesial and distal triangular fossae.

Figures 9g and 9k: Dissectional grooves

■ The marginal ridges are divided by dissectional grooves. On lower first premolars the mesial marginal ridge often has a well-defined dissectional groove which tends to be orientated lingually.

Figures 9h and 9l: LR5 and LR4 drawings complete

■ Complete the lower premolar drawings by rendering the outline form, cusp ridges and the fissure pattern.

Summary

The tooth drawing exercises described in this paper and its sequel attempt to overcome some of the challenges in teaching and learning tooth anatomy and guide the accurate, predictable, enjoyable restoration of patients with damaged teeth.

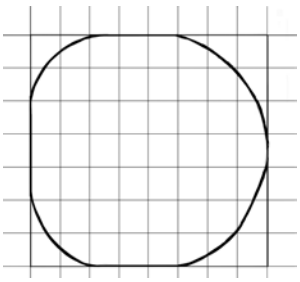

Figure 9a. Rounded square outline form

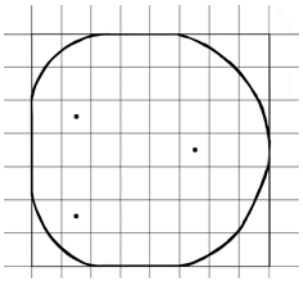

Figure 9b. Cusp tips

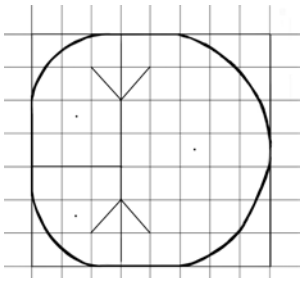

Figure 9c. Y-form fissure pattern

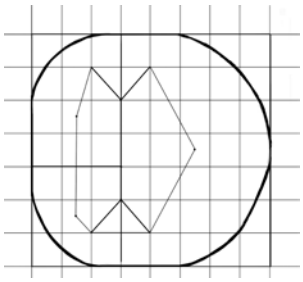

Figure 9d. Occlusal table *(drawn faintly)*

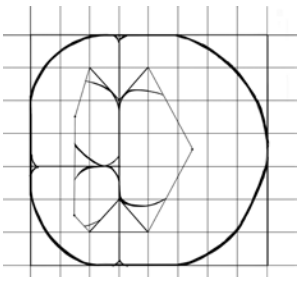

Figure 9e. Transverse (buccal) oblique (lingual) cusp ridges

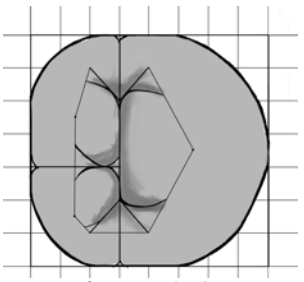

Figure 9f. Marginal ridges

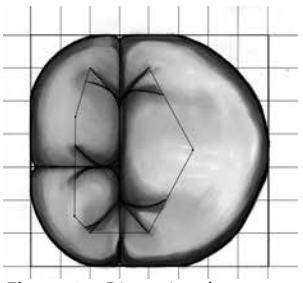

Figure 9g. Dissectional grooves

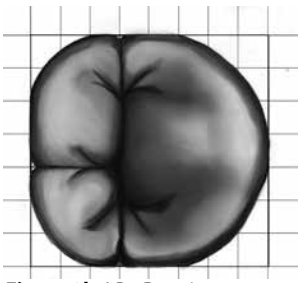

Figure 9h. LR5 Drawing complete

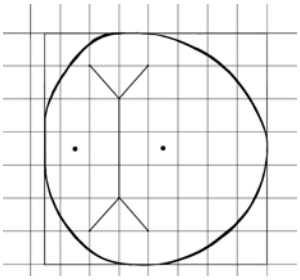

Figure 9i. Rounded outline form, cusp tips, fissure pattern

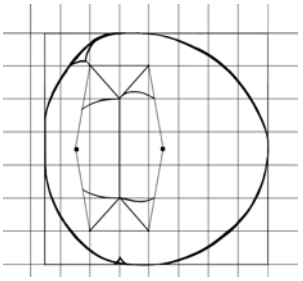

Figure 9j. Occlusal table *(drawn faintly)*

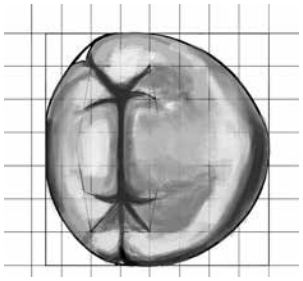

Figure 9k. Fossae/Marginal ridges/Dissectional grooves

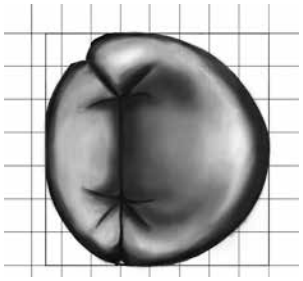

Figure 9l. LR4 Drawing complete

Figure 9. **(a–h)** Lower right second permanent premolar LR5. **(i–l)** Lower right first permanent premolar LR4.

Acknowledgements

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Footnote

The drawing exercises described in this series have been progressively modified based on student outcomes and feedback over seven years. The author would greatly welcome any suggestions for further refinements from students, clinical colleagues and academics. Please contact **L.Mackenzie@bham.ac.uk**

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