Appendix 4

Summary Table of the Root Canal Systems of the Permanent Mandibular Teeth

Blaine Cleghorn, and William Christie

Permanent Mandibular Teeth: Number of Canals

	NUMBER OF CANALS						No. of Studies	References	No. of Teeth	Most Common Anomaly or Variation (Number of Case Reports In Brackets)
	Most Common	1	2	3	4	Other				
Central incisors	1 Canal	84.3%	15.6%			0.1%	23	Verna, GR et al 2017 (118), Da Silva, EJ et al 2016 (64), Zhengyan, Y et al 2016 (120), Kayaoglu, G et al 2015 (121), Altunsoy, M et al 2014 (65), Han, T et al 2014 (122), Lin, Z et al 2014 (123), Liu, J et al 2014 (211), Aminsobhani, M et al 2013 (124), Sert, S and Bayirli, GS 2004 (3), Gomes, BP et al 1996 (212), Çaliskan, MK et al 1995 (4), Karagöz-Kücükay, I 1994 (213), Walker RT 1988 (214), Kaffee I et al 1985 (215), Bellizzi R and Hartwell G 1983 (216), Warren, EM and Laws, AJ 1981 (217), Miyoshi S et al 1977 (218), Vertucci FJ 1974 (125), Madiera MC and Hetem S 1973 (126), Pineda F and Kuttler Y 1972 (6), Laws AJ 1971 (219), Barrett MT 1925 (7)	14045	Dens invaginatus (6) Dens evaginatus (talon cusp) (6) 2 canals (6)
Lateral incisors	1 Canal	79.1%	20.8%			0.1%	23	Verna, GR et al 2017 (118), Da Silva, EJ et al 2016 (64), Zhengyan, Y et al 2016 (120), Kayaoglu, G et al 2015 (121), Altunsoy, M et al 2014 (65), Han, T et al 2014 (122), Lin, Z et al 2014 (123), Liu, J et al 2014 (211), Aminsobhani, M et al 2013 (124), Sert, S and Bayirli, GS 2004 (3), Gomes, BP et al 1996 (212), Çaliskan, MK et al 1995 (4), Walker, RT 1988 (214), Karagöz-Kücükay, I 1994 (213), Kaffe, I et al 1985 (215), Warren, EM and Laws, AJ 1981 (217), Bellizzi, R and Hartwell, G 1983 (216), Miyoshi, S et al 1977 (218), Vertucci, FJ 1974 (125), Madiera, MC and Hetem, S 1973 (126), Pineda, F and Kuttler, Y 1972 (6), Laws, AJ 1971 (219), Barrett, MT 1925 (7)	13748	2 canals (5) Dens invaginatus (4)

	NUMBER OF CANALS						No. of Studies	References	No. of Teeth	Most Common Anomaly or Variation (Number of Case Reports In Brackets)
	Most Common	1	2	3	4	Other				
Canines * 2 or more canals	1 Canal	91.2%	8.8%*				20	Soleymani, A et al 2017 (127), Da Silva, EJ et al 2016 (64), Shemesh, A et al 2016 (128), Zhengyan, Y et al 2016 (120), Kayaoglu, G et al 2015 (121), Altunsoy, M et al 2014 (65), Han, T et al 2014 (122), Somalinga, NS et al 2014 (66), Aminsobhani, M et al 2013 (124), Vaziri, P et al 2008 (220), Sert, S and Bayirli, GS 2004 (3), Caliskan, MK et al 1995 (4), Pecora, JD et al 1993 (130), Kaffee I et al 1985 (215), Vertucci, F 1984 (5), Bellizzi, R and Hartwell, G 1983 (216), Miyoshi, S et al 1977 (218), Green, D 1973 (23), Pineda, F and Kuttler, Y 1972 (6), Barrett, MT 1925 (7)	14377	2 roots and 2 canals (8) 2 roots and 3 canals (3) 1 root and 2 canals (3)
First premolar * 2 or more canals	1 Canal	72.2%	28.9%*				40	Alkaabi, W et al 2017 (132), Bürklein, S et al (2017) (9), Dou, L et al 2017 (133), Zhang, D et al 2017 (221), Abraham, SB and Gopinath, VK 2015 (134), Chen, J et al 2015 (222), Huang, Y-D et al 2015 (135), Kazemipoor, M et al 2015 (136), Kazemipoor, M et al 2015 (137), Llena, C et al 2014 (139), Ok, E et al 2014 (67), Shetty, A et al 2014 (223), Singh, S and Pawar, M 2014 (140), Alhadainy, HA 2013 (141), Liu, N et al 2013 (224), Yang, H et al, 2013 (142), Baroudi, K et al 2012 (225), Yu, X et al 2012 (143), Jain, A and, Bahuguna, R 2011 (144), Parekh, V et al 2011 (153), Rahimi, S et al 2007 (147), Kheddmat, S et al 2010 (145) , Velmurugan, N and Sandhya, R 2009 (226), Awawdeh, LA and Al-Qudah, AA 2008 (146), Lu, T-Y et al 2006 (227), Sert, S and Bayirli, GS 2004 (3), Yoshioka, T et al 2004 (228), Zaatar, EI et al 1997 (19), Çaliskan, MK et al 1995 (4), Sabala, CL et al 1994 (229), Baisden, MK et al 1992 (230), Geider, P et al 1989 (149), Walker, RT 1988 (231), Miyoshi, S et al 1977 (218), Vertucci, F 1978 (150), Green, D 1973 (23), Zillich, R and Dowson, J 1973 (154), Pineda, F and Kuttler, Y 1972 (6), Mueller, AH 1933 (24), Barrett, MT 1925 (7)	13086	3 roots and 3 canals (5) 1 root and 2 canals (5) 1 root and 3 canals (5) Dens evaginatus (4) 2 roots and 2 canals (3) 3 canals (3) C-shaped canal (4)

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	NUMBER OF CANALS						No. of Studies	References	No. of Teeth	Most Common Anomaly or Variation (Number of Case Reports In Brackets)
	Most Common	1	2	3	4	Other				
Second premolar * 2 or more canals	1 Canal	84.2%	15.8%*				25	Bürklein, S et al (2017) (9), Kazemipoor, M et al 2015 (136), Kazemipoor, M et al 2015 (137), Llena, C et al 2014 (139), Shetty, A et al 2014 (223), Singh, S and Pawar, M 2014 (140), Ok, E et al 2014 (67), Bolhari, B et al 2013 (152), Baroudi, K et al 2012 (225), Yu, X et al 2012 (143), Parekh, V et al 2011 (153), Rahimi, S et al 2009 (1), Awawdeh, LA and Al-Qudah, AA 2008 (146), Rahimi, S et al 2007 (147), Hasheminia, M and Hashemi, A 2005 (232), Sert, S and Bayirli, GS 2004 (3), Zaatar, El et al 1997 (19), Çalişkan, MK et al 1995 (4), Geider, P et al 1989 (149), Miyoshi, S et al 1977 (218), Vertucci, F 1978 (150), Green, D 1973 (23), Zillich, R and Dowson, J 1973 (154), Pineda, F and Kuttler, Y 1972 (6), Barrett, MT 1925 (7)	8733	3 canals (12) 2 roots and 2 canals (11) C-shaped canal (7) Dens evaginatus (6) 3 roots and 3 canals (6)
First molar (Two Roots) * 2 or more canals										Radix entomolaris (32) 2 roots and 5 canals (3M and 2D) (20) 2 roots and 4 canals (3M and D) (10) 2 roots and 5 canals (2M and 3D) (8) 2 roots and 6 canals (3M and 3D) (7)
Mesial	2 Canals	3.1%	95.7%	1.1%		0.2%	23	Mohammadzadeh Akhlaghi, N et al 2017 (157)Ja, ng, J-K et al 2013 (179), Kim, S-Y et al 2013 (180), Wang, Y et al 2010 (183), Al-Qudah, AA and Awawdeh, LA 2009 (164), Reuben, J et al 2008 (166), Jung, I-Y et al 2005 (81), Sert, S and Bayirli, GS 2004 (3), Gulabivala, K et al 2002 (185), Gulabivala, K et al 2001 (186), Wasti, F et al 2001 (84), Al-Nazhan, S 1999 (170), Zaatar, El et al 1998 (172), Zaatar, El et al 1997 (19), Rocha, LF et al 1996 (173), Çaliskan, MK et al 1995 (4), Yew, S and Chan, K 1993 (187), Goel, NK et al 1990 (233), Fabra-Campos, H 1985 (234), Vertucci, F 1984 (5), Hartwell, G and Bellizzi, R 1982 (110), Pineda, F and Kuttler, Y 1972 (6), Skidmore, AE and Bjorndal, AM 1971 (178)	6428	

	NUMBER OF CANALS						No. of Studies	References	No. of Teeth	Most Common Anomaly or Variation (Number of Case Reports In Brackets)
	Most Common	1	2	3	4	Other				
Distal	1 Canal	68.7%	31.3%*				24	Mohammadzadeh Akhlaghi, N et al 2017 (157), Wang, Y et al 2010 (183), Filpo-Perez, C et al 2015 in press (235), Jang, J-K et al 2013 (179), Kim, S-Y et al 2013 (180), Al-Qudah, AA and Awawdeh, LA 2009 (164), Pattanshetti, N et al 2008 (50), Reuben, J et al 2008 (166), Sert, S and Bayirli, GS 2004 (3), Gulabivala, K et al 2002 (185), Gulabivala, K et al 2001 (186), Wasti, F et al 2001 (84), Al-Nazhan, S 1999 (170), Zaatar, El et al 1998 (172), Zaatar, El et al 1997 (19), Rocha, LF et al 1996 (173), Çaliskan, MK et al 1995 (4), Yew, S and Chan, K 1993 (187), Goel, NK et al 1990 (233), Fabra-Campos, H 1985 (234), Vertucci, F 1984 (5), Hartwell, G and Bellizzi, R 1982 (110), Pineda, F and Kuttler, Y 1972 (6), Skidmore, AE and Bjorndal, AM 1971 (178)	6569	
First molar (Three Roots) * 2 or more canals										
Mesial	2 Canals	2.8%	97.2%*				8	Mohammadzadeh Akhlaghi, N et al 2017 (157), Rodrigues, CT et al 2016 (159), Kim, S-Y et al 2013 (180), Wang, Y et al 2010 (183), Al-Qudah, AA and Awawdeh, LA 2009 (164), Gulabivala, K et al 2002 (185), Gulabivala, K et al 2001 (186), Yew, S and Chan, K 1993 (187)	928	
Distobuccal	1 Canal	98.3%	1.7%*				8	Mohammadzadeh Akhlaghi, N et al 2017 (157), Rodrigues, CT et al 2016 (159), Kim, S-Y et al 2013 (180), Wang, Y et al 2010 (183), Al-Qudah, AA and Awawdeh, LA 2009 (164), Gulabivala, K et al 2002 (185), Gulabivala, K et al 2001 (186), Yew, S and Chan, K 1993 (187)	928	
Distolingual	1 Canal	100%					9	Mohammadzadeh Akhlaghi, N et al 2017 (157), Rodrigues, CT et al 2016 (159), Kim, S-Y et al 2013 (180), Chourasia, HR et al 2012 (161), Wang, Y et al 2010 (183), Al-Qudah, AA and Awawdeh, LA 2009 (164), Gulabivala, K et al 2002 (185), Gulabivala, K et al 2001 (186), Yew, S and Chan, K 1993 (187)	936	
Second molar (two roots) * 2 or more canals										C-shaped canal (19) Taurodontism (18) Fusion with a paramolar (7) 3 roots (MB, MLi, and D) and 3 canals (6) 1 root and 1 canal (6)

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	NUMBER OF CANALS						No. of Studies	References	No. of Teeth	Most Common Anomaly or Variation (Number of Case Reports In Brackets)
	Most Common	1	2	3	4	Other				
Mesial	2 Canals	16.5%	84.0%*				14	Akhaghi, NM et al 2016 (194), Kim, SY et al 2016 (195), Silva, EJNL et al 2013 (197), Neelakantan, P et al 2010 (200), Al-Qudah, AA and Awawdeh, LA 2009 (164), Sert, S and Bayirli, GS 2004 (3), Gulabivala, K et al 2002 (185), Gulabivala, K et al 2001 (186), Zaatar, El et al 1997 (19), Rocha, LF da Costa et al 1996 (173), Çaliskan, MK et al 1995 (4), Weine, FS et al 1988 (236), Vertucci, F 1984 (5), Hartwell, G and Bellizzi, R 1982 (110)	3293	
Distal	1 Canal	88.2%	11.8%				14	Akhaghi, NM et al 2016 (194), Kim, SY et al 2016 (195), Silva, EJNL et al 2013 (197), Neelakantan, P et al 2010 (200), Al-Qudah, AA and Awawdeh, LA 2009 (164), Sert, S and Bayirli, GS 2004 (3), Gulabivala, K et al 2002 (185), Gulabivala, K et al 2001 (186), Zaatar, El et al 1997 (19), Rocha, LF et al 1996 (173), Çaliskan, MK et al 1995 (4), Weine, FS et al 1988 (205), Vertucci, F 1984 (5), Hartwell, G and Bellizzi, R 1982 (110)	3293	
Third molar	2-3 Canals	6.9%	32.9%	51.0%	9.3%	2.2%	3	Somasundaram, P et al 2017 (207), Sidow, SJ et al 2000 (62), Guerisoli, DM et al 1998 (63)	420	Highly variable; variation is the norm

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