CHAPTER 5

5.1. Striae packing pattern in modern human molars

Reid *et al.*; (1998a) presented a study on crown formation time from a Medieval French population from La Picardie. This study was based on histological ground sections of the complete dentition of four individuals. Sections of the molars from Picardie were made available for the present study. Striae packing pattern (SPP) and the angles formed between the striae and the EDJ were measured in specimens shown in Tables 5.1, 5.5 and 5.6.

The number of lateral striae for each specimen and SPP are shown in Table 5.1. We made no attempt to statistically analyze differences or similarities between teeth and faces as we considered that the sample sizes were too small. However, we summarized some descriptive statistics on Table 5.2 and this information was further evaluated in Tables 5.3 and 5.4. The main intent of this exercise was to look for trends on these features.

Table 5.1. Striae count on molars for each decile. The totals obtained here are compared with the numbers obtained by Reid *et al*.; (1998a). Numbers highlighted in gray indicate estimates.

Striae Packing in Molars

		Deciles											
	Specimen/Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Reid et al (1998)**
EN13													
	LO L M1 MES BF	3	5	4	6	8	14	15	17	15	16	**103**	**103**
	LO L M1 DIST BF	2	2	4	5	5	9	11	14	25	24	**101**	
	LO L M1 DIST LF	2	2	3	3	5	7	11	18	20	21	**92**	
	LO L M2 MES BF	2	3	3	4	9	10	16	20	22	22	**111**	**115**
	LO L M2 MES LF	2	3	4	5	7	11	15	16	19	22	**104**	
	LO L M2 DIST LF	3	3	3	7	4	7	8	17	18	21	**91**	
T 49													
	LO L M1 MES BF	2	2	3	3	4	5	7	13	15	16	**70**	**72**
	UP L M2 MES BF	2	2	3	3	6	8	9	13	15	17	**78**	**69**
	LO L M2 MES BF	2	3	3	3	5	6	9	11	11	15	**68**	**70**
	UP R M3 MES BF	3	3	4	4	9	11	16	14	13	16	**93**	**92**
	LO L M3 MES BF	3	3	4	4	6	7	7	11	12	15	**72**	**72**
	LO L M3 MES LF	3	4	4	6	6	6	9	7	11	15	**71**	
	LO L M3 DIS LF	3	3	4	4	4	5	6	9	9	15	**62**	
	UP L M3 MES 1 LF	1	2	3	3	4	4	14	17	17	19	**84**	
	UP L M3 MES 1 BF	2	3	3	4	5	6	7	9	17	18	**74**	**68**
	UP L M3 MES 2 BF	3	3	2	3	3	7	11	11	15	16	**74**	

Table 5.2. Descriptive statistics of counts of lateral striae per tooth type on the specimens shown in Table 5.1. The mean for all molars is 84.25 striae.

	N	Mean	Min	Max	Range	SD
M1	4	91.5	70	103	33	15.11
M2	5	90.4	68	111	43	17.8
M3	7	75.71	62	93	31	9.9
All molars	**16**	**84.25**				

Table 5.3 Summary of mesial and distal counts on buccal and lingual faces for the samples shown in Table 5.1

Lo M1	Mes-BF	103, 70	Dis-BF	101
	Mes-LF	?	Dis-LF	92
Lo M2	Mes-BF	111, 68	Dis-BF	?
	Mes-LF	104	Dis-LF	91
Lo M3	Mes-BF	72	Dis-BF	?
	Mes-LF	71	Dis-LF	62
Upp M3	Mes-BF	93, 74, 74		
	Mes-LF	84		

Table 5.4. Averages of mesial and distal faces in buccal and lingual cusps (or faces) for the samples shown on Table 5.1

	Mes- BF	Mes- LF	Dis- BF	Dis- LF
	103	104	101	62
	70	71		92
	111	84		91
	68			
	72			
	93			
	74			
	74			
Means	**83**	**86.3**	**101**	**81.6**

Figure 5.1. Striae packing pattern (SPP) on the sections shown on Table 5.1 separated into mesial or distal faces and buccal and lingual.

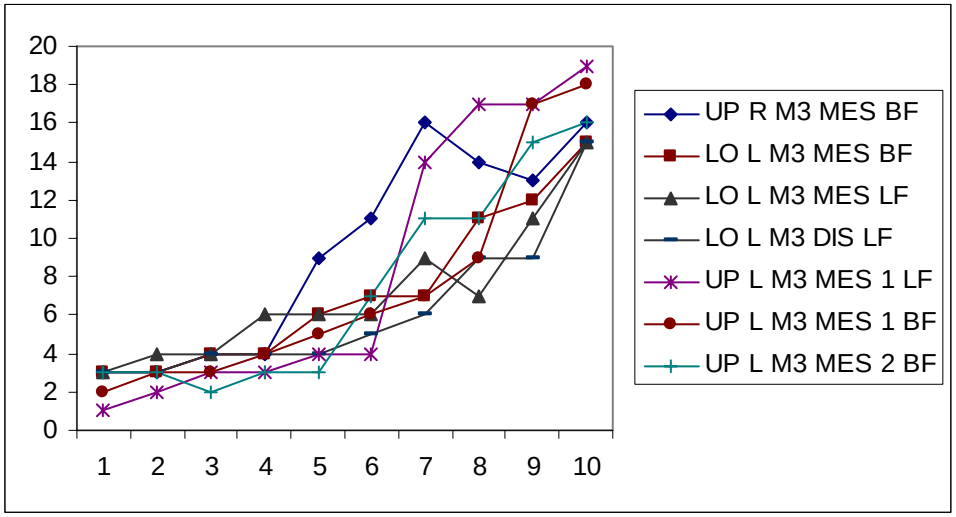
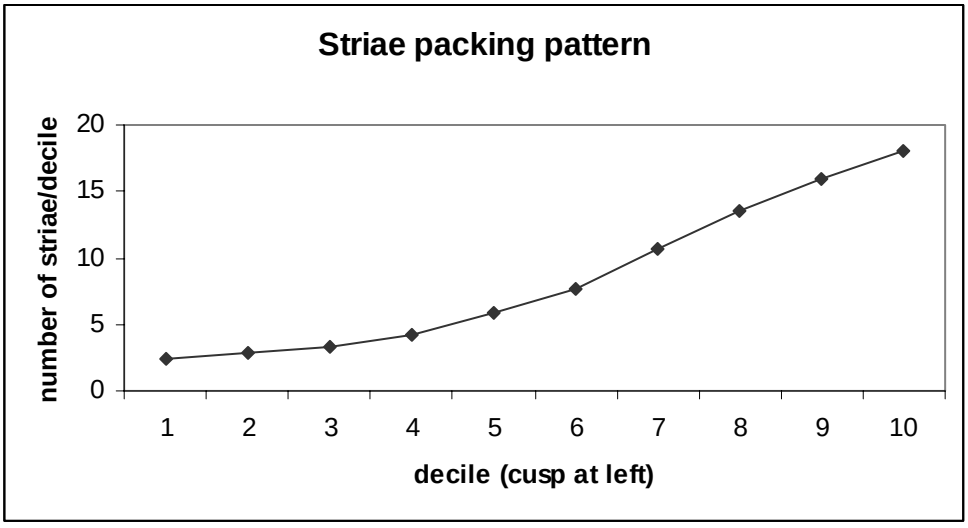


Figure 5.2. Striae packing pattern (SPP) for all of the sections combined showing a steady increase from cuspal (at left in this figure) to the cervix (right side).



5.2. Angles striae/EDJ in modern human molars

The EDJ was divided in 5 equal zones and as many angles as possible were measured at each zone. In most other studies (e.g. Beynon & Dean 1995; Ramirez Rozzi 1993; Smith *et al.*; 2004), it is common to divide the EDJ in 3 zones. However, we have attempted to add two more zones to assess whether this scheme would reveal more subtle changes in extension rates than dividing the EDJ in only 3 zones. Tables 5.5 and 5.6 show values of striae/EDJ for the specimens T-49 and EN-13. In the case of UP L M3 MES (Table 5.5), two sections of the buccal face were originally cut (BF 1 & 2). No differences were found in the means for any of the 5 zones studied between these sections. In general, no differences were found between buccal and lingual faces on the same sections of the same specimens.

Table 5.5. Values of striae/EDJ angles on 12 ground sections of the specimen T -49 from Picardie (Reid *et al.*; 1998a). The EDJ was divided in 5 equal zones. Values in parentheses indicate number of angles measured.

		Divisions				
		1	**2**	**3**	**4**	**5**
	Specimen/face					
T 49	UP L M3 MES LF	15 (1)	32.5 (4)	?	49.8 (4)	42.6 (5)
	UP L M3 MES BF-1	15 (3)	26 (3)	37 (3)	46.8 (5)	48.4 (5)
	UP L M3 MES BF-2	12 (3)	34 (3)	38 (2)	44 (3)	46 (4)
	UP R M3 MES BF	19.5 (2)	25 (6)	43 (5)	38 (5)	44 (5)
	LO L M3 MES BF	10 (1)	17.3 (3)	31 (6)	38.2 (4)	39 (4)
	LO L M3 MES LF	15 (2)	21.8 (5)	26.5 (5)	34.7 (4)	39 (4)
	LO L M3 DIS BF	18 (2)	25 (5)	29.2 (4)	39 (3)	43 (4)
	UP L M2 DIS BF	13 (1)	20 (5)	42.5 (2)	43 (4)	55 (4)
	UP L M2 DIS LF	16 (1)	22.5 (2)	42 (3)	46 (3)	56 (5)
	LO L M2 MES BF	15 (1)	23 (4)	30.2 (6)	40.2 (3)	40.5 (5)
	LO L M2 MES LF	13 (2)	22.8 (5)	33 (4)	36 (5)	39 (4)
	LO L M2 DIS BF	12 (2)	18 (3)	35.5 (4)	38.5 (5)	40 (4)

Table 5.6. Values of striae/EDJ angles on 12 ground sections of the specimen EN-13 from Picardie (Reid *et al.*; 1998a). The EDJ was divided in 5 equal zones. Values in parentheses indicate number of angles measured.

		Divisions				
		1	2	3	4	5
	Specimen/face					
EN13	LO R M1 MES 2 PROT	16 (2)	17 (5)	26 (7)	41 (9)	48 (4)
	LO R M1 MES 2 META	12 (1)	17.3 (3)	26.6 (5)	42 (4)	56 (4)
	LO R M1 MES PROT	13 (10)	25 (1)	40 (5)	42.4 (10)	42 (5)
	LO L M2 MES META	12 (2)	19 (2)	34.5 (4)	42 (6)	48. (5)
	UPP L M2 MES PAR	14 (1)	32 (1)	38 (3)	40 (9)	38 (8)
	LO L M1?	10 (1)	11.5 (2)	24 (2)	40 (8)	45.3 (4)
	LO L M1 DIST ENTOC	8 (1)	15.5 (2)	32.6 (6)	42.6 (6)	39.6 (4)
	LO L M1 MES PROT	8 (1)	16 (4)	30 (4)	43.7 (7)	39 (4)
	LO L M2 MES PROT	11 (2)	30 (2)	35.5 (7)	45.6 (3)	38.5 (7)
	LO ?	15 (2)	23 (3)	37 (4)	44 (2)	53 (5)
	?????	16 (1)	21.3 (4)	39 (4)	51 (4)	49 (5)

Table 5.7. Mean values for each face and total mean value for each division.

	1	2	3	4	5
M1 BF	12.3	19.3	32	42.4	42.5
M1LF	10	16.4	29.6	43.2	47.3
M2 BF	13	24.6	36.3	41.5	41.3
M2 LF	13.7	21.4	36.5	41.3	47
M3 BF	14.9	25.5	40.8	37.1	47.3
M3 LF	15	27.1	38.5	42.3	39.8
MEANS	***13.1***	***22.4***	***35.6***	***42***	***44.2***

Figure 5.3. Trends observed on angles striae/EDJ on M1 from this study separated by face.

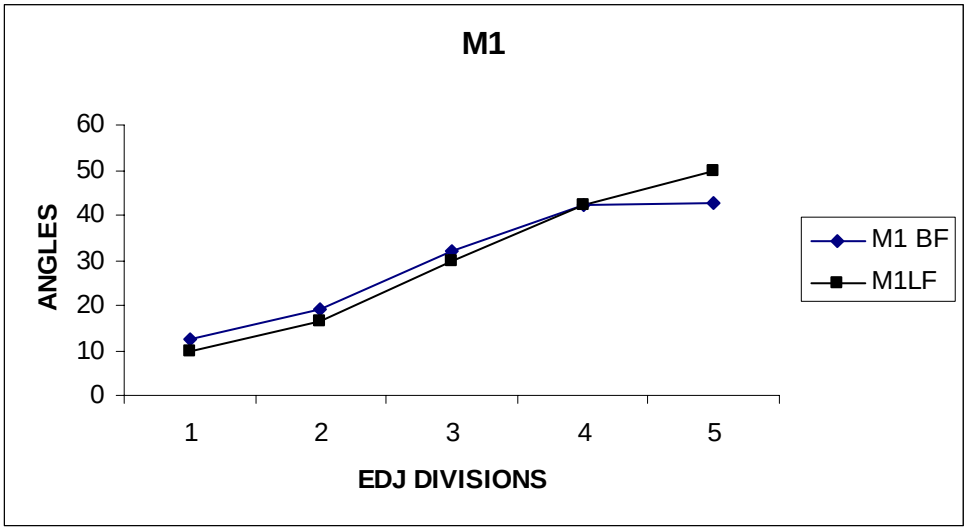


Figure 5.4. Trends observed on angles striae/EDJ on M2 from this study separated by face.

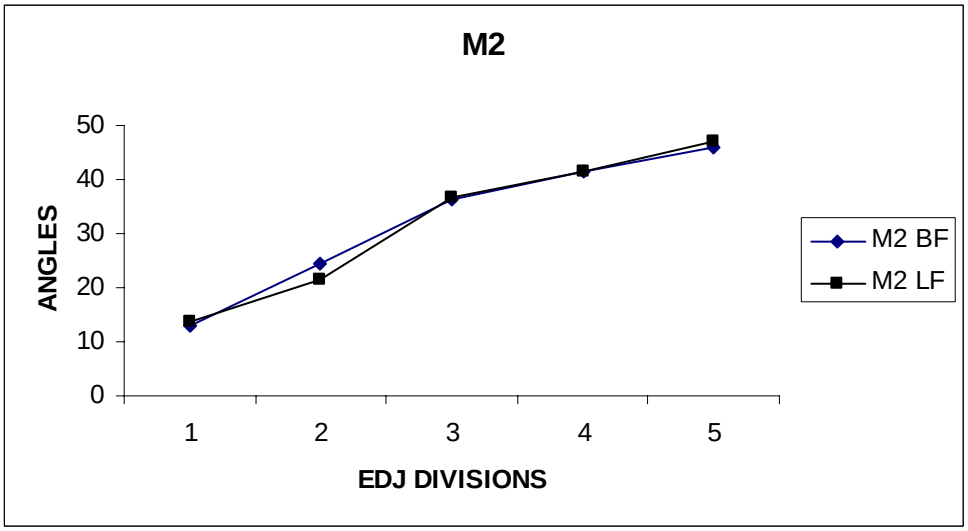


Figure 5.5. Trends observed in angles striae/EDJ on M3 from this study separated by face.

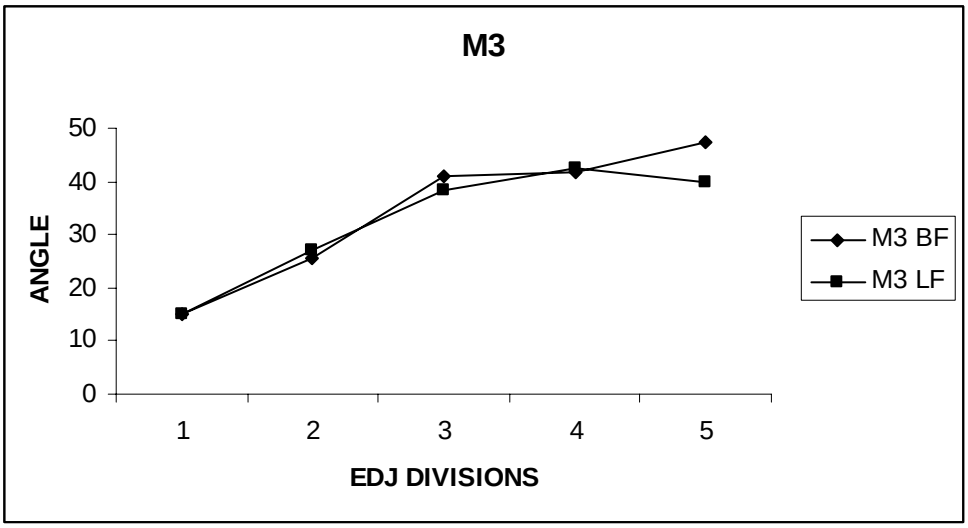
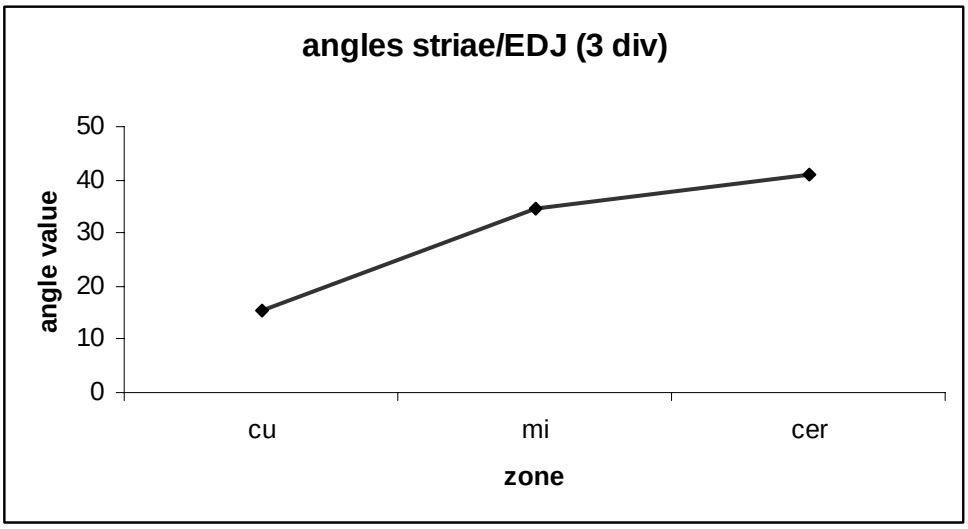


Table.5.8. Some sections of EN 13 were observed to decrease in angle values when the EDJ had been divided in 5 zones. As most studies on striae/EDJ angles usually compare only 3 zones, to assess possible differences between our study and others, we further divided these specimens in 3 divisions. Our results indicate that even when values appear to decrease towards the cervix in a 5 division scheme; these values do no decrease in schemes that use only 3 divisions.

EN 13	
L M2 LO MES PROT	**17.3 (3)**
	35 (7)
	39.6 (10)
L M1 LO MES PROT	**12 (3)**
	33 (9)
	42 (9)
L M1 LO DIST ENTO	**10 (2)**
	34 (7)
	42.5 (9)
L M2 UPP MES PAR	**23 (1)**
	35.7 (7)
	39.5 (11)

Figure 5.6. Trends observed in striae/EDJ angles of the specimens presented in Table 5.5. This pattern is similar to that in figure 5.4 in which an increase is shown from cuspal to cervical zones along the EDJ.



5.3. Discussion

The values of striae/EDJ reported here appear to show a trend in which angles increase from the cuspal to the cervical areas of the EDJ (Figures 5.6 & 5.7) indicating that *H. sapiens* show a decelerated ameloblast extension rate as the development of the crown approaches the cervical end. This trend had already been noted in *H. sapiens* (Beynon & Reid 1995; Macho & Wood 1995). The values of angles striae/EDJ obtained here either using a 3 or a 5 division scheme, are higher than values reported by Beynon & Reid (1995) for a sample of 20 ground sections of modern humans. Their study divided the EDJ in 3 zones, and the means obtained are shown in Table 5.7.

Table 5. 9. Values striae/EDJ measured by Beynon & Dean (1995).

Homo	n=20	cervical= 32.0	lateral= 27.0	cuspal= 13.0

The discrepancies between the higher values obtained in the present study and those of Beynon & Reid (1995) could be due to differences in the measurement scheme employed by each study. Our study measured the angles right at the EDJ, rather than main trends in the long axis shown by striae. In some cases, measuring tangents from two potentially curved surfaces can be problematic. Also, Beynon & Reid (1995: p 320)

measured only striae “at the mid point of each third”, while we measured striae along the entire surface of each zone.

5.4. Results of daily appositional rates in modern humans

The tables below (Table 5. 6 to 5. 16) show descriptive statistics of the measurements of cross striation spacing or daily rates measured for this study from specimens detailed in Table 3.6. This information is compared to values obtained by Beynon *et al.*; (1991) (Table 5. 17). In our study we measured cuspal rates just slightly more cervically than shown in Beynon *et al.*; (1991, Figure 2C) to be able to include some specimens with minimal cuspal wear.

(mes= mesial; dis= distal; LF= lingual face; BF= buccal face; MH= recent samples derived from dentist practice).

Table 5. 10.

SEP: lo M2 Mes-BF	N	Max	Min	Range	Mean	SD
Cus. Out	11	5.75	5.30	0.45	5.54	0.15
Cus. Mid	11	5.80	4.00	1.80	5.06	0.62
Cus. Inn	10	3.60	2.30	1.30	3.03	0.57
Lat. Out	16	6.60	4.00	2.60	5.43	0.89
Lat. Mid	12	5.30	4.20	1.10	4.75	0.34
Lat. Inn	9	3.30	2.50	0.80	3.00	0.23
Cerv. Out	11	4.30	3.30	1.00	3.79	0.39
Cerv. Inn	9	3.30	2.20	1.10	2.72	0.43

Table 5.11.

SEP 2 lo M2 Dis-LF	N	Max	Min	Range	Mean	SD
Cus. Out	15	6.00	5.30	0.70	5.50	0.29
Cus. Mid	12	5.00	4.00	1.00	4.44	0.35
Cus. Inn	10	3.50	2.50	1.00	2.86	0.32
Lat. Out	15	5.60	4.00	1.60	4.14	0.57
Lat. Mid	10	5.00	3.80	1.20	4.32	0.44
Lat. Inn	8	3.00	2.60	1.40	2.77	0.39
Cerv. Out	11	4.70	3.50	1.20	3.86	0.41
Cerv. Inn	11	3.50	2.20	1.30	2.72	0.40

Table 5.12.

F 54 upp M1 Mes-BF	N	Max	Min	Range	Mean	SD
Cus. Out	13	6.00	4.00	2.00	4.90	0.65
Cus. Mid	12	5.30	3.30	2.00	4.45	0.62
Cus. Inn	12	4.60	2.50	2.10	3.59	0.64
Lat. Out	12	4.60	3.30	1.30	4.06	0.46
Lat. Mid	10	5.00	3.30	1.70	4.04	0.65
Lat. Inn	8	4.00	2.20	1.80	2.77	0.61
Cerv. Out	?	?	?	?	?	?
Cerv. Inn	7	3.50	2.30	1.20	2.66	0.40

Table 5.13.

F 54 upp M2 Mes-BF	N	Max	Min	Range	Mean	SD
Cus. Out	15	5.6	4.50	1.1	5.01	0.45
Cus. Mid	14	6.00	4.60	1.40	4.99	0.47
Cus. Inn	11	3.30	2.50	0.80	2.75	0.26
Lat. Out	16	5.50	3.60	1.90	4.58	0.66
Lat. Mid	10	5.00	3.30	1.70	4.04	0.65
Lat. Inn	8	3.50	2.20	1.30	2.88	0.51
Cerv. Out	10	4.50	4.00	0.50	4.18	0.19
Cerv. Inn	7	3.50	2.40	1.10	2.67	0.42

Table 5.14.

F 83 lo M1 Mes-LF	N	Max	Min	Range	Mean	SD
Cus. Out	14	6.0	4.70	1.30	5.41	0.52
Cus. Mid	12	5.00	4.60	0.40	4.85	0.14
Cus. Inn	11	2.60	2.20	0.40	2.37	0.21
Lat. Out	16	5.30	4.50	0.80	4.81	0.37
Lat. Mid	12	5.10	4.00	4.00	1.10	0.47
Lat. Inn	7	3.00	2.20	0.80	2.64	0.34
Cerv. Out	11	4.20	3.00	1.20	3.75	0.42
Cerv. Inn	6	2.50	2.20	0.30	2.3	0.10

Table 5. 15.

F 83 lo M1 Dis-LF	N	Max	Min	Range	Mean	SD
Cus. Out	12	5.5	5.00	0.5	5.35	0.22
Cus. Mid	11	5.00	4.00	1.00	4.53	0.36
Cus. Inn	10	3.00	2.30	0.70	2.7	0.27
Lat. Out	15	5.00	4.00	1.00	4.41	0.39
Lat. Mid	12	4.30	3.50	0.80	3.73	0.29
Lat. Inn	6	3.00	2.50	0.50	2.67	0.16
Cerv. Out	10	4.20	3.50	0.70	3.71	0.28
Cerv. Inn	9	2.50	2.00	0.50	2.15	0.2

Table 5.16.

F 83 lo M1 DF*	N	Max	Min	Range	Mean	SD
Cus. Out	12	5.60	4.00	1.60	4.81	0.64
Cus. Mid	12	4.50	3.40	1.10	4.06	0.49
Cus. Inn	11	3.30	2.00	1.30	2.75	0.45
Lat. Out	17	6.10	5.00	1.10	5.37	0.46
Lat. Mid	11	4.50	4.00	0.50	4.39	0.17
Lat. Inn	11	3.50	2.40	1.10	3.00	0.44
Cerv. Out	12	3.60	3.00	0.60	3.4	0.25
Cerv. Inn	8	2.50	2.00	0.50	2.3	0.22

Table 5.17.

MH 1 up M1 Mes-BF	N	Max	Min	Range	Mean	SD
Cus. Out	11	5.60	4.50	1.10	5.10	0.37
Cus. Mid	12	4.80	4.30	0.30	4.60	0.20
Cus. Inn	11	3.00	2.40	0.60	2.73	0.23
Lat. Out	16	5.00	4.40	0.60	4.78	0.25
Lat. Mid	11	5.00	3.80	1.20	4.09	0.43
Lat. Inn	7	3.00	2.30	0.70	2.70	0.29
Cerv. Out	?	?	?	?	?	?
Cerv. Inn	7	3.00	2.50	0.50	2.69	0.25

Table 5.18.

MH 2 lo M3 Dis- LF	N	Max	Min	Range	Mean	SD
Cus. Out	12	6.00	4.50	1.50	5.26	0.57
Cus. Mid	10	5.00	3.80	1.20	4.33	0.49
Cus. Inn	10	3.00	2.30	0.70	2.59	0.26
Lat. Out	16	5.30	4.00	1.30	4.63	0.56
Lat. Mid	11	5.00	3.80	2.20	4.46	0.44
Lat. Inn	7	2.70	2.30	0.40	2.51	0.12
Cerv. Out	12	4.00	3.00	1.00	3.45	0.40
Cerv. Inn	7	3.00	2.30	0.70	2.59	0.26

Table 5.19.

MH 3 lo M1 Mes-LF	N	Max	Min	Range	Mean	SD
Cus. Out	11	5.9	4.30	1.6	5.61	0.29
Cus. Mid	12	5.20	4.10	1.10	4.27	0.44
Cus. Inn	9	2.90	2.10	0.80	2.42	0.21
Lat. Out	15	5.30	3.90	1.40	4.82	0.42
Lat. Mid	12	4.90	3.50	1.40	4.17	0.38
Lat. Inn	7	3.00	2.20	0.80	2.41	0.27
Cerv. Out	11	4.20	3.20	1.00	3.38	0.35
Cerv. Inn	7	2.90	2.20	0.70	2.42	0.15

Table 5.20. Summary of daily appositional rates obtained by this study. Means are highlighted.

M.H. and Picardie molars	N	Range	Min	Max	Mean	SD	SE
Cuspal outer	56	2.0	4.0	6.0	***5.2***	0.58	7.7
Cuspal mid	55	2.5	3.3	5.8	***4.5***	0.55	7.4
Cuspal inner	53	2.0	2.0	4.0	***2.8***	0.43	6.0
Lateral outer	51	3.3	3.3	6.6	***4.8***	0.67	9.4
Lateral mid	54	2.2	3.3	5.5	***4.3***	0.50	6.9
Lateral inner	54	1.8	2.2	4.0	***2.8***	0.42	5.7
Cervical outer	33	1.7	3.0	4.7	***3.5***	0.44	7.8
Cervical inner	37	1.5	2.0	3.5	***2.6***	0.44	7.8

Table 5.21. Summary of mean appositional rates reported by Beynon *et al.*; (1991) in molars of *H. sapiens*.

Cuspal outer	5.1
Cuspal mid	4.3
Cuspal inner	2.7
Lateral outer	5.0
Lateral mid	4.0
Lateral inner	2.6
Cervical outer	2.8
Cervical inner	2.3

5.5. Discussion

The values obtained in our sample can be compared with values obtained by Beynon *et al*.; (1991) which used the same method for measuring daily appositional rates. However, it must be pointed out that the study of Beynon and co-workers did not specify molar type or face studied. Results obtained in the present study are remarkably similar to those obtained by Beynon *et al*.; (1991) in all regions of the molar crown with one exception, the cervical outer enamel for which the present study recorded values about 22% greater.