Anomalous Malocclusions in Windover Pond (8BR246): The Origins of Anterior Dental Crowding in the Florida Archaic

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INTRODUCTION

Anterior dental crowding has a multifactorial etiology, consisting primarily of environmental influences and polygenic factors. High rates of dental crowding are most prominent in societies practicing an agricultural subsistence and are rare in foraging societies. This trend has been associated with masticatory stress and its effects on the craniofacial and dental arch shape, as described in Carlson and Van Gerven's (1977) masticatory function hypothesis and Price's (1936) Disuse Theory. This study has investigated the high rates of dental crowding in the Early Archaic Windover sample from Florida. Comparative tests were conducted on other Early and Middle Archaic samples from Florida examining the relationship of dental crowding to tooth size, arch size, and dental wear.

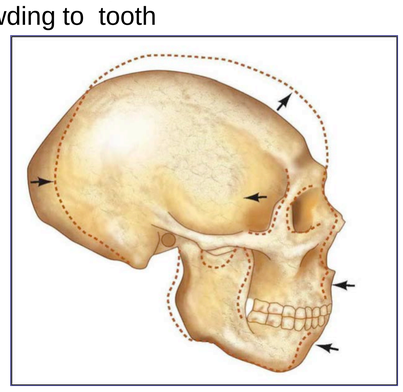


Figure: Craniofacial reduction over time from dietary shift to softer more processed foods. Arrows represent a reduction in mastication and maxillomandibular complex and cranial length. Uppermost arrow represents the heightening of the cranial vault. Dotted lines outline these changes. Image adapted from Carlson and Van Gerven (1977): 502

METHODS

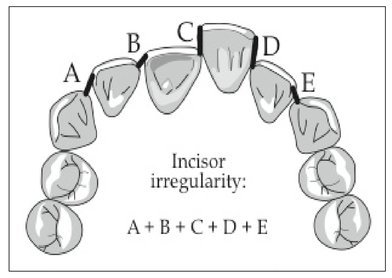
- Crowding Severity- Little's (1975) Irregularity Index (Figure upper right)
- Arch Width- chord AB (Figure lower right)
- Arch Depth (D)- calculated as median height of a triangle from arch chords AC, BC and AB (Figure lower right), using the formula:

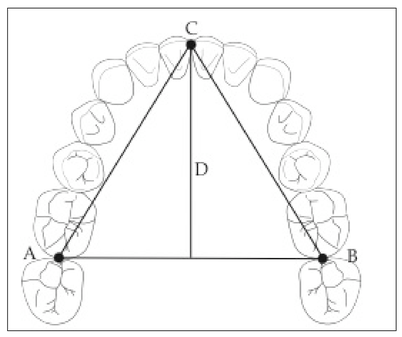
$$D = \sqrt{\frac{AC^2 + BC^2}{2} - \frac{AB^2}{4}}$$

- Tooth Size- Mesiodistal breadths were recorded for all maxillary and mandibular anterior teeth by measuring the maximum dimension along the mesiodistal plane.
- Attrition- Smith's (1984) dental surface wear scoring system and Scott's (1979) quadrant scoring system.
- Dental wear patterns- grooved wear patterns were described, recorded and analyzed.
- Nonmetric traits- were scored on all teeth (R and L) in the samples under study. Arizona State University Dental Anthropology System (ASUDAS) standard ranges were used to record 34 traits and their variance.

Statistical Analyses

- Fisher's Exact tests- computation of exact *P*-value for analyses of discrete/nominal variables (ILL severity analyses, nonmetric frequencies, sex and age frequencies).
- Mann-Whitney U- differences of continuous variables between two or more samples (dental metrics, arch depth, arch width).
- Kruskal-Wallis – compare sample distributions (for two or more sample comparisons).
- Comparisons of means and standard deviations- arch depth, arch width, mesiodistal widths, and cranial metrics





Figures from Harris and Corruccini (2008):6-7

Skeletal Samples

Site	Temporal Range ^{14}C yrs. BP	Subsistence	N
Windover (8BR246)	Early Archaic 8,120-6,990	Riverine	89
Warm Mineral Springs (8SO19)	Early Archaic 11,950-9,950	Riverine	5
Little Salt Springs (8S018)	Middle Archaic 6,900-6,085	Riverine	6
Bay West (8CR200)	Middle Archaic 6,710-6,550	Marine	9
Republic Groves (8HR4)	Middle Archaic 6,585-5,640	Riverine	6
Harris Creek at Tick Island (8VO24)	Middle Archaic 5,640-5,030 BP	Riverine	34
Gauthier (8BR193)	Middle-Late Archaic 3,300- 1,600 BP	Riverine	20

Figure: Two severe dental crowding cases in Windover. Occlusal view (left), anterior view (right).

LII Dental Crowding Comparison of Samples

Site	Sample	Good Occlusion	Total Crowding	Mild Crowding	Moderate Crowding	Severe Crowding
Windover	%	53%	47%	13%	9%	25%
n = 89	#	47	42	12	8	22
Little Salt Springs	%	100%	0	0	0	0
n = 6	#	6	0	0	0	0
Gauthier	%		20%	10%	0	10%
n = 20	#	16	4	2	0	2
Republic Groves	%	100%	0	0	0	0
n = 6	#	6	0	0	0	0
Tick Island	%	68%	32%	15%	12%	6%
n = 34	#	23	11	5	4	3
Bay West	%	89%	11%	11%	0	0
n = 9	#	8	1	1	0	0

Windover LII Dental Crowding within Age Cohorts

Site	Sample	Good Occlusion	Total Crowding	Mild Crowding	Moderate Crowding	Severe Crowding
Child (1-9yrs)	%	70%	30%	0	15%	15%
n = 13	#	9	4	0	2	2
Juvenile (10-20yrs)	%	17%	83%	17%	8%	58%
n = 12	#	2	10	2	1	7
Y. Adult (21-34yrs)	%	25%	75%	15%	15%	45%
n = 20	#	5	15	3	3	9
M. Adult (35-49yrs)	%	82%	28%	16%	4%	8%
n = 25	#	18	7	4	1	2
O. Adult (50+ yrs)	%	67%	33%	17%	5%	11%
n = 18	#	12	6	3	1	2
O. Adult (50+ yrs)	%	67%	33%	17%	5%	11%
n = 18	#	12	6	3	1	2

LII Dental Crowding Comparison of Samples

Site	Date Range (yrs BP)	Sample	Good Occlusion	Total Dental Crowding	Severe Crowding
Pickwick Basin, AL Hunter-gatherers	7,000-3,000	%	80%	20%	0
n = 30		#	24	6	0
Pickwick Basin, AL Agriculturalists	1,200-1,500 AD	%	53%	37%	10%
n = 30		#	16	11	3
Jomon, Japan Hunter-gatherers	3,000-2,000	%	80%	20%	2%
n = 45		#	36	9	1
Kofun, Japan Proto-Agriculturalists	1,800-1,600	%	54.5%	45.5%	9%
n = 11		#	6	5	1
Medieval, Japan Agriculturalists	680-580	%	48%	52%	18%
n = 50		#	24	26	9
Yedo, Japan Agriculturalists	400-100	%	44%	56%	25%
n = 16		#	7	9	4
Yanomami, Brazil Slash and Burn Horticulture	Modern	%	47%	53%	unknown
n = 148		#	70	78	unknown
Xavante, Brazil Slash and Burn Horticulture	Modern	%	95%	5%	0
n = 37		#	35	2	0

Japanese data from Hanihara et al. 1981: 66, North American data from Newman and Snow (1942): 397; Yanomami data from Pereira et al., (1994): 9, Xavante data from Neel et al. (1964): 107

RESULTS

Anterior Dental Crowding

- Windover exhibits unusually high dental crowding frequencies for a hunter-gatherer society
- Mild/moderate crowding rates are similar between Windover and other prehistoric populations

Age Cohorts in Windover

Dental crowding rates are the highest in juvenile and young adult groups. There is a trend of decreasing dental crowding frequency with age in the adult groups.

Sex Cohorts in Windover

Dental crowding rates were similar between sex cohorts within the Windover sample

Tooth Size Arch Size Discrepancy (TSASD) Factors in Windover

TSASD is a condition found to be the product of environmental influences. Mesiodistal tooth width means within Windover did not exhibit significant correlations between dental crowding and tooth size but correlations were observed between longer arch depth means in females and shorter arch width means in males.

Arch Depth

Arch depth correlates with dental crowding in the female sample but not for males.

- Females- Differences in arch depth between the dental crowding and good occlusion females are significant; P-values = 0.002 (maxilla) and 0.001 (mandible).
- Males- Means for arch depth are not significant between occlusal groups: maxilla (p = 0.611) or the mandible (p = 0.202).

Arch Width

Both sexes exhibit significantly different distributions between the good occlusion and dental crowding groups for mandibular arch width but non-significant values for maxillary arch width.

- Females- Non-significant distributions between the two groups for maxillary arch width (p = 0.742), significant values for mandibular arch width (p = 0.040).
- Males- Non-significant distributions for maxillary arch width (p=.651) and significant values for mandibular arch width (p = 0.026).

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DISCUSSION/CONCLUSION

Dental crowding development within Florida Archaic populations has different primary influences based on crowding severity; there is a general non-pathological predisposition for approximately 25 percent of individuals to exhibit mild to moderate crowding despite heavy masticatory use. Mild/moderate crowding in the Windover and comparative samples is similar to rates recorded in other prehistoric foraging societies, indicating a normal occlusal variant within these samples. Severe dental crowding is atypical in prehistoric groups, the rates of severe dental crowding in the Windover sample may be the result of environmental influences. This is demonstrated by the association of TSASD and crowding observed in Windover. Assessments of arch depth and arch width between sex and occlusal cohorts in Windover show correlations between dental crowding and increased arch depth (maxillary and mandibular) in the females but not in the males. Correlations between dental crowding and reduced mandibular arch width in the Windover males and females were also observed in this study. These data suggest similar environmental influences acting on the mandible (reducing arch width) are contributing to dental crowding development in both males and females. However, differences in the maxillary and mandibular arch depth between the sexes demonstrates sex specific correlations between arch depth and dental crowding. Despite the equal distribution of dental crowding between males and females, these differences suggest gender-specific environmental effects on arch shape between males and females in Windover.

The severe crowding frequencies recorded at Windover are likely the result of cultural practices involving the dentition. In particular, non-masticatory cultural practices (e.g., using teeth as tools) might alter cranial-facial formation differently than is discussed in Carlson and Van Gerven's (1977) masticatory function hypothesis; these practices might have caused the odd combination of heavy attrition and severe dental crowding. Windover is exemplary of a non-agricultural group whose high dental crowding frequencies are attributable to cultural practices.

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