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PARTIAL RESULTS OF ANALYSIS OF DENTAL WEAR IN SAMBAQUI ON ILHA DA BOA VISTA I, CABO FRIO, RJ

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Abstract: The shell mound Ilha da Boa Vista I, is located in the district of Tamoios, municipality of Cabo Frio, Rio de Janeiro, located on one of the sandy cords of the plain between the rivers Una and São João, dating between 3480±100 BP and 3110±60 AP (ORSTOM, number 1077). The main objective of this text concerns the study of dental wear of human remnants buried in this shell mound, in relation to the pattern of distribution of occlusal wear, seeking to correlate it with the diet and its abrasive content, in order to contribute to the understanding of the living conditions of this group. From the recovered archaeological series, the material selected for the present study consists of 14 individuals with an estimated age range and gender, and with teeth in the arches that can be observed in the majority, totaling 247 teeth. The studied segment was divided into categories of oral wear, namely: mild, moderate and intense, for a better interpretation. As a result, the category of moderate occlusal tooth wear predominated in the entire series studied, suggesting the frequent presence of abrasive elements in the group's diet.

Keywords: dental wear, sambaquis, oral health, biocultural context.

INTRODUCTION

Paleopathological studies, from a biocultural and paleoepidemiological perspective, seek to explore the relationships between the way of life of human populations and the pathophysiological changes resulting from health-disease processes, which may occur due to the lifestyle of groups (Buikstra & Cook, 1992; Mendonça de Souza, 1995). Since the 1970s, studies on dentition and its particularities have gained greater emphasis in research, related to the livelihood patterns of past human populations, even though previous studies of dental pathologies are cited in the bioanthropological literature. In the 1980s, with the objective of establishing an epidemiological perspective of the health-disease processes in groups of the past, countless studies began to be focused on changes in lifestyle and subsistence patterns, with emphasis on studies of dental paleopathology in the reconstitution of the cultural and economic transitions with the potential to express such processes (Hillson, 1996). The dental arch, given its main function for food, configures its own characteristics that result in great sources of biocultural information. The mouth, with a chewing function to reduce the size of food, is the first organ to suffer the impact of consumed food, responding directly - as in the case of abrasions and eventual breakages - or indirectly - as in the case of cavities - to the its influences. Consequently, we can establish relationships between eating practices and modification processes or pathologies in the teeth and also in the mouth (Hillson, 1996; Rodrigues, 1997). Some of these processes are cumulative throughout life (Salles Cunha, 1968; Salles Cunha, 1969, Lukacs, 1989). Dental enamel is the most resistant and most mineralized human tissue in the body, this characteristic allows a greater chance of preservation in archaeological pieces, making teeth study materials of great value for Archeology and Paleopathology (Brothwell, 1981; Hillson, 1996). As there is no possibility of remodeling the enamel due to regenerative inability, there are records of events that occurred during the individual's life from his tooth formation until his death, even after death if there is no taphonomic interference (Hillson, 1996). In particular, studies in dental paleopathology were and are carried out in an attempt to reconstruct the diet of archaeological populations, through the analysis of oral health indicators, sometimes focusing on isolated dental-pathological processes, sometimes combining them, according to the hypotheses

in test and the theoretical-methodological concepts of each time (Lukacs, 1989). Seeking to contribute to oral health studies of shellfish populations, the research to be addressed in this study sought to characterize the intensity of tooth wear in human remains in individuals buried and recovered at the Ilha da Boa Vista I site and compare it with the specialized literature.

MATERIAL AND METHODS

The archaeological series under study was recovered during the excavations of the Sambaqui Ilha da Boa Vista I site, coordinated by the archaeologist MaDu Gaspar in the years 1991, 1995 and 1996. Human burials and archaeological levels containing scattered human bones from disturbed levels were excavated, in an area corresponding to 660m², about a quarter of the surface of the site. The material was under the safeguard of the National Museum, in the Biological Anthropology Sector of the National Museum / ``Universidade Federal do Rio de Janeiro`` - SABMN / UFRJ until 2018, before the fire that destroyed the collections of the collection.

Of the 58 recovered individuals, 14 were selected in a reasonable state of preservation, with an estimated age range and gender (ages between 12 and 50 years or older), with a greater number of teeth in the arches. The sum totaled 247 teeth available for examination. The group was divided into wear categories: light, moderate and intense, for a better interpretation, following in general terms the methodology used by Rodrigues (1997).

The analyzes were performed macroscopically with the aid of a table magnifying glass, Instrutherm brand, with 8 magnifications. Tooth wear was analyzed using a scoring system to measure the degree of wear. Differentiated scores were used for the analyzes between molars and the other groups of teeth, following the proposal by

Rodrigues (1997). For the teeth, incisors, canines and premolars, the Smith scale was used (1984, apud Buikstra & Ubelaker, 1994). This scale considers 8 distinct levels of wear, and takes into consideration, the entire occlusal/incisal surface. In this scale (Table 1), the analysis procedures are not the same for all tooth types. Incisors and canines are analyzed using a different criterion than those used for premolars. In the group of premolars, they are also differentiated, considering their superior or inferior position in the arch (Rodrigues, 1997). For molars, the Scott score scale (1979, apud Buikstra & Ubelaker, 1994) was used, which divides the occlusal surface into 4 equal quadrants (Table 2). The score for each quadrant is calculated based on a scale from 1 to 10. The sum of the 4 quadrants will constitute the wear score for each tooth, which then constitutes a scale from 4 to 40. Teeth with lesions and/or damage to the quadrants, which prevented the analysis of wear, were excluded from the analysis. In both scores, the scales refer the initial level of wear to the absence, or slight polishing, of the dental faces, and the most intense level to the complete loss of the dental crown, when there is no remaining enamel. In this case, the observations focused on the left side of the arches, with replacement by the right side, in case of absence of teeth in the left side arches (Rodrigues, 1997). After determining the scores, and to simplify the analysis, the quantitative classification of tooth wear was transformed into discontinuous categories: mild (L), moderate (M) and severe (I), as proposed by Rodrigues (1997), grouping for the anterior and posterior teeth scores. This way, for the anterior teeth, light wear gathered the equivalent scores of 1 to 3; moderate wear, scores from 4 to 6; and for severe wear, scores from 7 to 8, as shown in Table 1. The molars were divided into quadrants for each tooth, and with their sum, the following scores were

considered: from 1 to 15 light wear, while scores from 16 to 30, moderate wear and tear, intense wear comprised values from 31 to 40, as shown in Table 2 (Rodrigues, 1997). After analyzing all the teeth, the results were gathered in tables and graphs, with different scores in batteries of anterior and posterior teeth. For classification of dental groups in tables and graphs, we use the following abbreviations: **Ic** (Central incisor), **Il** (Lateral incisor), **C** (Canine), **Pm1** (Premolar 1), **Pm2** (Premolar 2), M1 (Molar 1), **M2** (Molar 2) and **M3** (Molar 3). At the end of the analysis, photographic records of some dental arches were taken to compose this work, using the Canon Powershot SX200 IS Digital Camera, with the use of a standing table in order to maintain the photographic pattern and the homogeneity of the images.

Degree of wear	Incisors and Canines	Premolars
1	Macroscopically imperceptible wear when polished or with small veneers (without dentin exposure)	From non-etched to polished or with small veneers (no dentin exposure)
2	Punctual or linear dentin exposure	Moderate removal of cusps
3	Dentin line of different thickness	Complete removal of cusps and/or moderate loss of dentin
4	Moderate dentin exposure without looking like a line	At least one large exposure of dentin on one of the cusps
5	Large dentin area, with a complete dentin ring	Two large areas of dentin (may be slightly coalescent)
6	Large area of dentin, with loss of an enamel ring on one side, or only the presence of very thin enamel	Areas of coalesced dentin, with an enamel ring still complete
7	Loss of enamel ring on two sides or just small traces of enamel	Total dentin exposure; loss of enamel ring on at least one side
8	Complete loss of crown, without enamel; crown surface takes the shape of the roots	Severe loss of crown height; the surface of the crown takes the shape of the roots

Table 1. Description of the different degrees of occlusal wear according to Smith's ordinal scale (1984).

Adapted from Smith (1984)

Escores	Description
0	Lack of available information (tooth out of occlusion, unerupted, *antemortem* or *post-mortem* tooth loss, etc.)
1	Imperceptible or very small wear facets
2	Large wear facets, but large cusps and surface features (pits and fissures) are still present. It is possible that there are spots of exposed dentin, which must be ignored. This is a quadrant with a lot of enamel.
3	Any cusp in the quadrant area may be rounded rather than defined as in score 2. The cusp is becoming recessed but is not yet flat from wear
4	Quadrant area flat from wear (horizontal) but no exposed dentin
5	Flat quadrant, with exposed dentin one-quarter quadrant or less. (Care must be taken not to confuse a natural pit with exposed dentin)
6	Increased dentin exposure: More than a quarter of the quadrant area is involved, but much enamel is still present. If the quadrant is visualized as having three sides (an almost triangular geometric figure), the region of exposed dentin will still be surrounded by an enamel ring on three sides
7	Enamel is observed on only two sides of the quadrant.
8	There is enamel on only one side of the quadrant (usually the outer edge), but the enamel is medium to heavy in thickness
9	There is enamel only on one side of the quadrant, as in stage 8, but the enamel is very thin – just a band. Another part of this edge may be worn in one or more places.
10	There is no enamel anywhere in the quadrant - complete dentin exposure. Wear is extended below the cervical margin to the root

Table 2. Scott system for assigning scores for molar wear.

Adapted Scott (1979)

RESULTS

Considering all the individual records (Table 3), in the Mild category, third molars predominated with 38.8% of occurrences, followed by second premolars with 27.8% and first premolars with 25%. The other teeth had percentages below or equal to 10%, with the exception of canines (11.7%) and second molars (15.2%). In the Moderate category, first molars predominated (72.9%), followed by central incisors (60.8%). In the category of intense wear, lateral incisors predominated with 40%, followed by canines with 36.1%.

Third molars had the lowest occurrences, with 5.6% (See Graph 1).

Categories	L		M		I	
Teeth	N	%	N	%	N	%
Ic	2	8,7	14	60,8	7	30,4
Il	3	10	15	50	12	**40**
C	4	11,7	17	50	13	38,3
Pm1	9	25	14	38,9	13	36,1
Pm2	10	27,8	16	44,4	10	27,8
M1	1	2,7	27	**72,9**	9	24,3
M2	5	15,2	18	54,5	10	30,3
M3	7	**38,8**	10	55,5	1	5,6
Total	41	16,6	131	53	75	30,4

Table 3 – Percentage of wear intensity by type of tooth, for entire arches. In bold, the highest percentage values observed.

Considering the general data for the left side in both arches (Table 4), it is observed that in the Light category, the highest occurrences were observed in the third molars (55.6%). In the Moderate category, the highest values are found in central incisors (69.3%), followed by first molars (63.6%). In the Intense category, canines have the highest values, with a percentage of 45% (See Graph 2).

Categories	L		M		I	
Teeth	N	%	N	%	N	%
Ic	1	7,7	9	**69,3**	3	23
Il	2	11,1	9	50	7	38,9
C	2	10	9	45	9	**45**
Pm1	5	22,7	8	36,4	9	40,9
Pm2	6	27,3	10	45,4	6	27,3
M1	3	13,6	14	63,6	5	22,7
M2	5	26,3	7	36,8	7	36,8
M3	5	**55,6**	3	33,3	1	11,1
Total	29	20	69	47,6	47	32,4

Table 4 – Percentage of intensity of wear on the left side by type of tooth, for the entire arches. In bold, the highest percentage values.

Considering the general results for the entire dentition (Table 5), distributed by gender, it was observed that the wear in the Moderate category predominated among males with 57.7% of occurrences, while among females the Intense wear predominated, with 56. 9% of occurrences (see Graph 3).

| Categories	L		M		I	
Gender	N	%	N	%	N	%
Feminine	3	5,2	22	37,9	33	**56,9**
Masculine	38	**20,1**	109	**57,7**	42	22,2
Total	41	16,6	131	53	75	30,4

Table 5 – Percentage of wear intensity between genders of entire individuals for both arches. Higher percentage values in bold.

Considering the distribution of wear in this subgroup by age range (Table 6), observing the total number of teeth studied, adolescents predominated in the Light category, with 62.5% of occurrences, no occurrences were observed in this category among adults, and mature adults had a percentage of 5.2% occurrences. In the Moderate category, young adults predominated, with percentages very close to mature adults (respectively 57.8% and 56.4%). In the Intense category, adults predominated, with 84.2% of occurrences, no occurrences of adolescents were observed in this category (see Graph 4).

Categories	L		M		I	
Age Groups	N	%	N	%	N	%
Adolescent	10	**62,5**	6	37,5	0	0
Young-adult	29	16,7	100	**57,8**	44	25,4
Adult	0	0	3	15,8	16	**84,2**
Mature-adult	2	5,2	22	56,4	15	38,5
Total	41	16,6	131	53	75	30,4

Table 6– Percentage of wear intensity between age groups of entire individuals for both arches. Highest percentage values in bold.
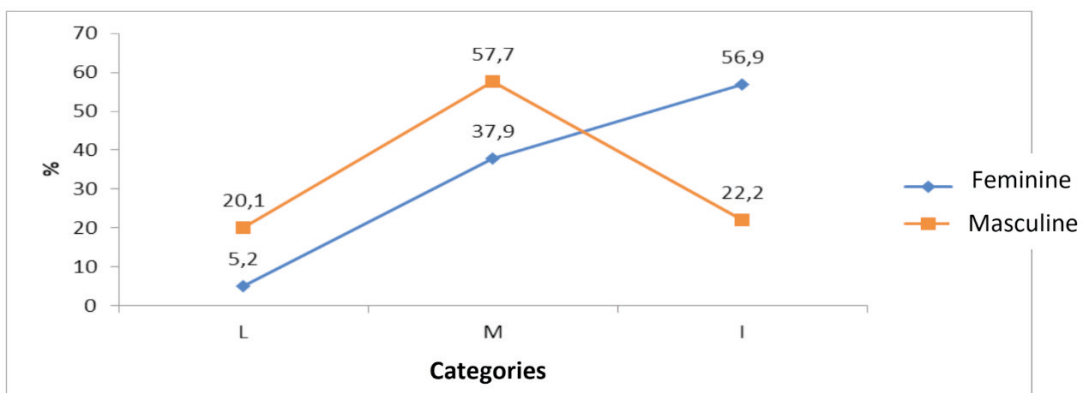
When considering the distribution by gender and age groups for the entire dentition of this subgroup (Tables 7 and 8), it must be taken into consideration, that there are no
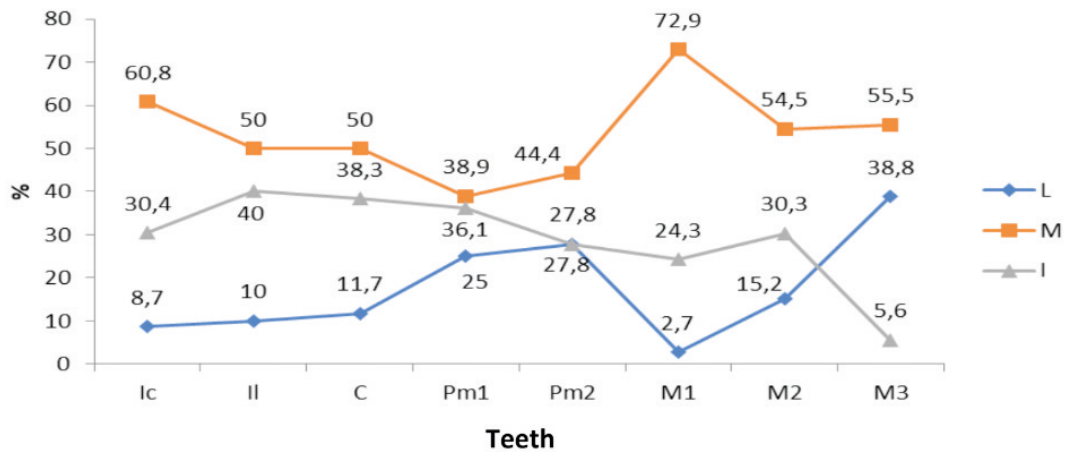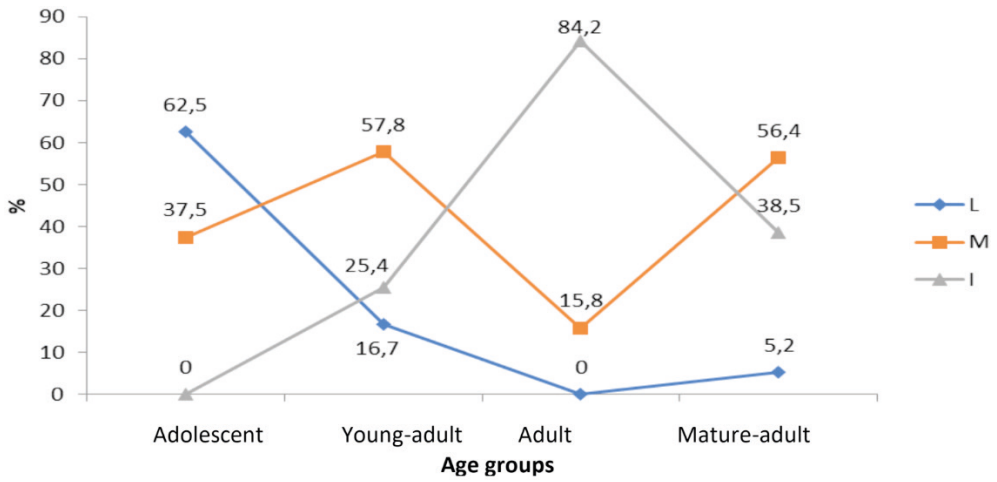
Graphic 1. Distribution of wear, by registered individuals, with all occurrences.
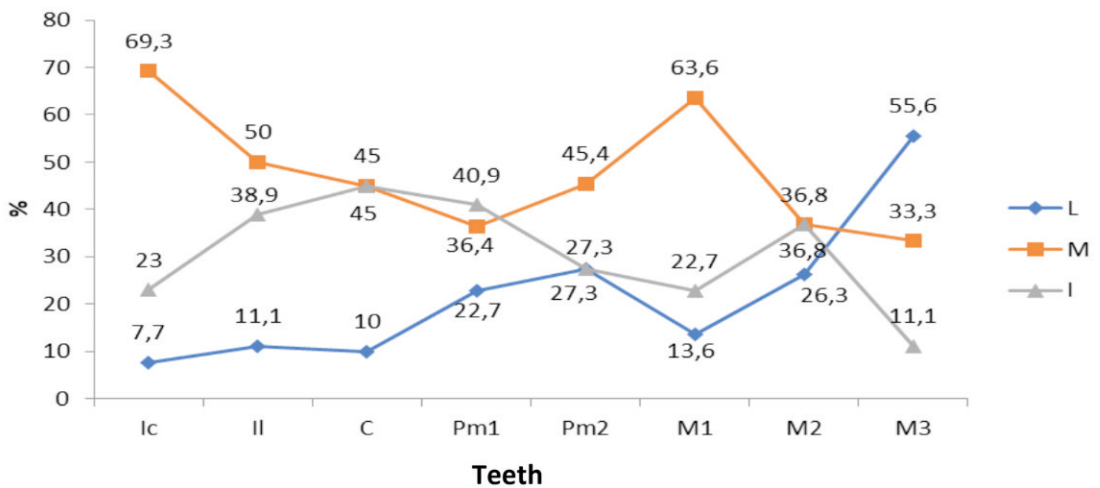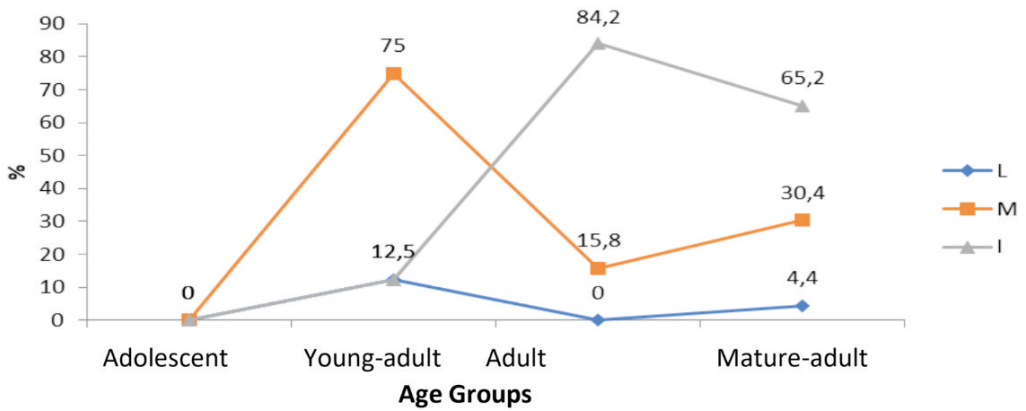

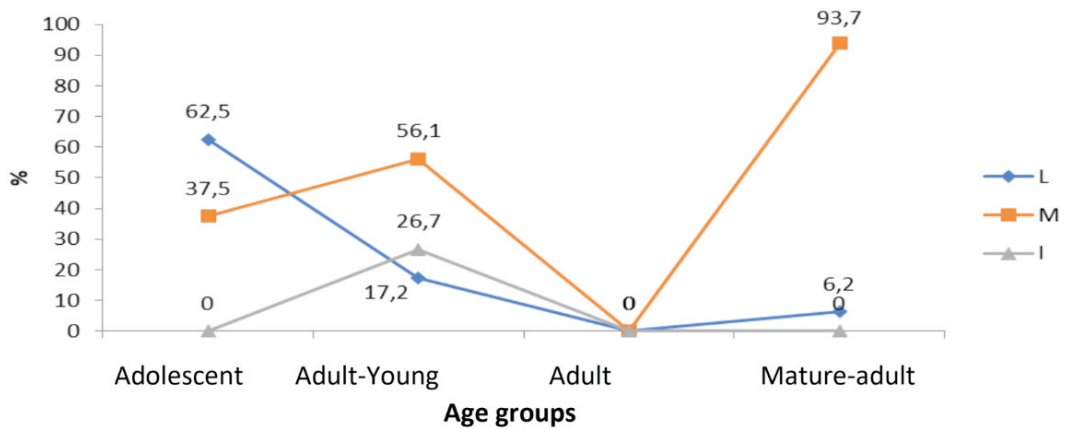Graph 2. Wear distribution, left side of whole individuals, both arcades.

Graph 3. Distribution of wear levels between genders of entire individuals, throughout the dentition.

Graph 4. Distribution of wear levels by age group for both arches of entire individuals.

Graph 5. Distribution of wear among females and by age groups, both arches.

Graph 6. Distribution of wear between males and age groups, both arches.

female adolescents and male adults. In the Light category, among females, the highest occurrences are in young adults, with 12.5%; in males, the predominance is of adolescents, with 62.5% of occurrences. Among male young adults, the percentages do not differ much from females, reaching 17.2%. In the Moderate category, female young adults have the highest percentages (75%), while among males the highest percentages are among mature adults (93.5%). Intense wear is predominant among females in adults and among males it occurs only in young adults, with only 26.7% of occurrences (see Graphs 5 and 6).

	Feminine						
Categories	L		M		I		
Age Groups	N	%	N	%	N	%	NTotal
Adolescent	0	0	0	0	0	0	0
Young-adult	2	**12,5**	12	**75**	2	12,5	16
Adult	0	0	3	15,8	16	**84,2**	19
mature-adult	1	4,4	7	30,4	15	65,2	23
Total	3	5,2	22	37,9	33	56,9	58

Table 7 – Percentage of wear intensity for females and age groups, both dental arches of entire individuals. Highest percentage values in bold.

	Masculine						
Categories	L		M		I		
Age groups	N	%	N	%	N	%	Total
Adolescent	10	**62,5**	6	37,5	0	0	16
Young-adult	27	17,2	88	56,1	42	**26,7**	157
Adult	0	0	0	0	0	0	0
Mature-adult	1	6,2	15	**93,7**	0	0	16
Total	38	20,1	109	57,7	42	22,2	189

Table 8– Percentage of wear intensity for males and age groups, both dental arches of entire individuals. Highest percentage values in bold.

FINAL CONSIDERATIONS

The study at Sambaqui Ilha da Boa Vista I showed, in general terms, that moderate occlusal wear predominates in the series. The predominance of this type of wear, using a similar methodology, had already been described by Rodrigues (1997) and by Wesolowski (2007). Such results, combined with other elements of his analysis, allowed the suggestion of a gradual polishing of the enamel. The more invasive the components of the diet, the more severe the tooth wear and thus providing through their analyzes information on food preparation and eating habits of a population (Powell, 1985; Walker et al., 1991). Possible agents that cause tooth wear frequently identified among groups of coastal fishermen are sand and ash (Mendonça de Souza, 1995). Other probable agents are phytoliths (Wesolowski, 2007) and ingestion of fish with bones (Mendonça de Souza, 1995). Studies show that the eating practices of shell mound builders included a quantity of plant foods and their by-products, as in the case of palm trees, hearts of palm; coconuts and starch from the trunk found in jerivás; faces; among other fruits and wild roots (Levi-Strauss, 1987; Sauer, 1987; Scheel-Ybert, 2001 & 2002). Only from the analysis of macroscopic wear it is not possible to establish the role of food and intrusive residues (sand, ash, etc.) in promoting wear, although it is consistent to suggest that for coastal populations, both cases contributed to the establishment of the pattern of wear. observed wear. For the 14 subjects in the present study, adolescents and young adults are numerically equivalent to adults and older adults. In all the cases analyzed, the third molar was less affected by wear, prevailing, in most cases, with light levels of wear. This situation is expected, considering the late formation and eruption time of these teeth. The identified individuals showed a distinct

pattern of strain between genders, with a higher frequency of intense strain among female individuals, while moderate strain predominated in males. It is not possible to rule out a probable sample bias, since there are no adolescent individuals among the analyzed females nor adult males. This fact is corroborated by the observation that among male individuals, young adults always present percentages above 20% for intense wear. Among females, this only occurs in the lower dentition. The predominance of flat-type wear suggests, according to Smith (1984), the consumption of fibrous and resistant foods, characteristic of hunter-gatherer diets, (Molnar & Molnar, 1990). more intense use of vegetables in the diet of groups that build shell mounds, leading to consider them as probable groups of mixed economy (Klokler et al.; 2018; Sheel-Ybert and Boyadjian, 2020) putting in check the traditional interpretations, at least for coastal sites in the country and pointing to the need for new interpretive models for the wear patterns found. Based on the results obtained in this study, we hope to contribute to broadening the debate on dietary patterns and oral health of prehistoric groups on the Brazilian coast.

REFERENCES

BROTHWELL, D. 1981. Digging up bones. Londres: Oxford University Press. 200p.

BUIKSTRA, JE & COOK, DC. 1992. Paleopatologia. In Araújo AJG, Ferreira, LF, coordenadores. Paleopatologia e Paleoepidemiologia. Estudos multidisciplinares. Panorama ENSP. Rio de Janeiro: ENSP/FIOCRUZ, p 41- 85.

BUIKSTRA, JE & UBELAKER, DH. 1994. Standards for data collection from human skeletal remains. Arkansas archaeological survey research series, n.44. Fayetteville: Arkansas Archaeological Survey, 206 p.

HILLSON, S. 1996. Dental Anthropology. Cambridge: Cambridge University Press.

KLOKLER, Daniela M.; GASPAR, Maria Dulce; SCHEEL-YBERT, Rita. Why clam? Why clams? Shell Mound construction in Southern Brazil. Journal of Archaeological Science: Reports, v. 20, p. 856-863, 2018. DOI: https://doi.org/10.1016/j.jasrep.2018.06.015.

LEVI-STRAUSS C. 1987. O uso das plantas silvestres da América do Sul tropical. In Ribeiro BG, coordenadora. Suma Etnológica Brasileira, vol 1, Etnobiologia. Petrópolis: Editora Vozes, p 29-46.

LUKACS, JR. 1989. Dental paleopathology: Methods for reconstructing dietary patterns. In: Reconstruction of life from the skeleton. Iscan, MY, Kennedy, KA, editores. New York: AR Liss, p. 261-286.

MENDONÇA DE SOUZA, SMF. 1995. Estresse, doença e adaptabilidade: Estudo comparativo de dois grupos pré-históricos em perspectiva biocultural. [Tese de Doutorado] Rio de Janeiro: Escola Nacional de Saúde Pública, Fundação Oswaldo Cruz.

MOLNAR S; MOLNAR I. 1990. Dental arch shape and tooth wear variability. Am J Phys Anthropol; 82: 385-95.

POWELL, ML. 1985. The analysis of dental wear and caries for dietary reconstruction. In The analysis of prehistoric diets, Gilbert RI; Mielke JH (eds). San Diego, CA: Academic Press; p 307-338.

RODRIGUES, CD. 1997. Patologias e processos dento-maxilares em remanescentes esqueletais de dois sítios pré-históricos no Brasil: o cemitério de Furna do Estrago (PE) e o Sambaqui de Cabeçuda (SC). Dissertação de Mestrado. Escola Nacional de Saúde Pública/Fundação Oswaldo Cruz, RJ.

SALLES CUNHA E. 1969. Abrasões dentárias de adaptação. In Salles-Cunha E, organizador. Anais da sétima jornada fluminense de odontologia "Prof. Coelho e Souza"; Out 20-25; Niterói; Brasil. p.14-20.

SALLES CUNHA M. 1968. Abrasão: Registro de observações sobre prevalência, colhidas entre duas tribos indígenas. Arquivos Fluminenses de Odontologias, 1(3): 3- 7.

SAUER, CO. 1987. As plantas cultivadas na América do Sul tropical. In Ribeiro BG, coordenadora. Suma Etnológica Brasileira, vol 1, Etnobiologia. Petrópolis: Editora Vozes, p 59-90.

SCHEEL-YBERT, Rita. Man and vegetation in the Southeastern Brazil during the late Holocene. Journal of Archaeological Science, v. 28, n. 5, p. 471-480, 2001a. DOI: https://doi.org/10.1006/jasc.2000.0577.

SCHEEL-YBERT, R. 2002a. Late Holocene south-eastern Brazilian fisher-gatherhunter: environement, wood exploitation and diet. In Thiébault, S editor. Charcoal analysis: Methodological approaches, palaeoecological results ans woos uses. Proceedings of the seconde international meeting of anthracology. Paris: Archaeopress, p.159-168.

SCHEEL-YBERT, Rita; BOYADJIAN, Célia H. C. Gardens on the coast: considerations on food production by Brazilian shellmound builders. Journal of Anthropological Archaeology, v. 60, p. 101211, 2020. DOI: https://doi.org/10.1016/j.jaa.2020.101211.

SCOTT, EC. 1979. Dental wear scoring technique. Am J Phys Anthropol, 51:213- 218.

SMITH, BH. 1984. Patterns of Molar Wear in Hunter-gatherers and Agriculturists. Am J Phys Anthropol, 63: 39-56.

WALKER PL, DEAN G, SHAPIRO P. 1991. Estimating age from tooth wear in archaeological populations. In Advances in Dental anthropology, Kelley M, Larsen CS (eds). New York, NY: Wiley-Liss; 169-178.

WESOLOWSKI, V, SOUZA, SMFM, REINHARD, K. 2007. Grânulos de amido e fitólitos em cálculos dentários humanos: contribuição ao estudo do modo de vida e subsistência de grupos sambaquianos do litoral sul do Brasil. Revista do Museu de Arqueologia e Etnologia, São Paulo, 17: 191-210.