Occlusal Wear - An Age Determinant

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ABSTRACT:

Context: Age estimation, a sub-discipline of forensic sciences is gaining importance day by day in person identification. Not exactly atleast far possibilities should help to narrow down the search in identifying a person. Despite age estimation is of broader importance in forensic research and clinical dentistry but also a kind of social benefits in society when individuals are unaware of their age. As days pass by human body undergoes certain degenerative changes, amongst which occlusal wear of teeth is one of the physiological process which can be an age determinant.

Aims and Objectives: The aim of the present study was to estimate age of an individual by occlusal wear based Kim's scoring system.

Materials and Methods: To obtain a high level of accuracy, investigation has been confined to limited number of subjects, teeth and age group. Degree of occlusal wear was examined in maxillary and mandibular posterior teeth of 75 individuals of an age range 19 to 58 years. Scores were designated as per Kim's scoring system and age estimation was calculated by linear equation derived from regression analysis.

Results: The investigation revealed a significant positive correlation of teeth examined and age estimated with a difference of 1.52 years that of actual age. Study has also proved the increased wear in males than females.

Conclusion: Ultimately, an enlightening association of occlusal wear and Kim's scoring system are reliable determinants and markers in age estimation.

Key words: Forensic odontology, age estimation, occlusal wear, Kim's scoring system.

INTRODUCTION

Teeth have been extensively used as a source of human identification especially when soft tissue cannot provide reliable information.¹ Teeth being the central component of the masticatory apparatus of the skull are of good sources of material for civil

and medico-legal identification. In addition, the degree to which they provide resistance to damage makes them valuable for forensic investigation and research.² A number of reports in the field of forensic odontology have dealt with estimating chronological age in humans, living or dead for legal procedures,

to identify the victims during mass disasters and for anthropological studies.^{3,4} With the changing age profiles resulting in a greater number of older individuals in most countries and with improving dental health, increasing numbers of patients are presenting with extensive tooth wear.⁵ Wear is deterioration as a result of use. Tooth wear has existed since the beginning of humanity and in all civilizations that occurs systematically and intensively, but is considered a physiological process. In addition, it depends on many complex mechanisms, synchronous or sequential, synergetic or additive which can also often mask its true origin. In dentistry, wear is a generic term commonly used to describe phenomena of attrition (proximal and occlusal inter-dental friction), abrasion (friction with the intervention of particles) and erosion (chemical dissolution).⁶

There have been various methods like Schour and Massler's, Demirjian's and Gustafson's to determine age which required and included invasive procedures and confined to only few teeth of a particular age group. Although all these methods had certain drawbacks, they were modified to overcome. Amongst these various age estimating methods, Kim's system seems to be more reliable as it can be applied to wide age range without involving any invasive and time consuming procedures and is based only on the finding of occlusal wear. As occlusal wear is an age related degenerative change and could probably be a sign indicating the time period of teeth exposure to the oral cavity, it can be considered to be reliable aid in estimating age of an human. The study is undertaken with a purpose of estimating age of an individual by occlusal wear of teeth based on Kim's scoring system.

MATERIALS AND METHODS

Subject Selection

In this retrospective study 75 individuals, 39 males and 36 females grouped of known chronological age between 19 and 58 years were retrieved from the patients' files of the Department of Oral and Maxillofacial Pathology, Kamineni Institute of Dental Sciences. Inclusion criteria of the

present study were sound premolars and molars and individuals with no distinct dental malocclusion. Exclusion criteria were history of any operative or prosthetic treatments, a missing tooth in premolar and molar areas, parafunctional habits (chewing, bruxism) and anterior teeth.

Methodology

Dental impression was taken with elastic cromo impression material on an impression tray of both jaws. Maxillary and mandibular dental study models were obtained of each subject. All the sixteen permanent posterior teeth were examined for tooth wear with the naked eye under good illumination. Scoring was performed based on two different criteria which are horizontal factor and vertical factor. Horizontal factor denotes the area of tooth wear and vertical factor denotes the degree of dentin exposure. To obtain an accurate score combination of both the horizontal and vertical factors were considered in the scoring system. Tooth wear score has been classified into a 0 – 8 point scale according to Kim's scoring system based on pattern, number and amount of tooth wear. (Table 1)

SCORING

All the sixteen teeth of each patient were evaluated for tooth wear and scored individually. Amongst the scores of sixteen teeth in an individual, the highest degree was designated as tooth wear score (Table 2).

The estimated age of patient was calculated by adding an intercept to the sum of numerical values obtained.

$$Y = aX + b$$

- Y = Estimated Age
- a = Intercept (18.541)
- b = Regression co-efficient (3.625)
- X = Tooth wear score

As an illustration, $Y = 18.541 + 3.625 (3) = 29.41$. Here the estimated age of the patient was 29.4 years and actual age was 31 years.

RESULTS

Means and standard deviation for individual tooth wear were calculated for males and females separately to determine the gender differences (Table 3). There was a gradual increase in tooth wear score with aging in each and every tooth in both males and females ($p < 0.01$). Degree of tooth wear in males was higher than those in females. Regression analysis of age against tooth wear score were done to examine the relationship between age and tooth wear score (Table 4). The regression

analysis showed that the degrees of correlation were relatively strong between tooth wear scores of all examined teeth (coefficient of determination, $r^2 = 0.002 - 0.752$). The correlation between tooth wear scores of molars ($r^2 = 0.158 - 0.752$) was greater than premolars ($r^2 = 0.002 - 0.635$). The estimated age has been calculated by adding an intercept to the sum of numerical values. Difference between estimated and actual ages is only 1.52 years. The method described here provided a high level of accuracy. (Table 3:)

Table 1: KIM's Scoring System of Toothwear

SCORE	PREMOLAR	MOLAR
0	No visible wear	No visible wear
1	1P / 1L	1P / 1L / 2P / 2L
2	2P / 2L / 1S / 1B	3P / 3L / 4P / 4L / 1S / 1B / 2S / 2B
3	2S / 2B	3S / 3B / 4S / 4B
4	Wear on more than 2/3 occlusal surface	
5	1Pc / 1Lc	1Pc / 1Lc / 2Pc / 2Lc
6	2Pc / 2Lc / 1Sc / 1Bc	3Pc / 3Lc / 4Pc / 4Lc / 1Sc / 1Bc / 2Sc / 2Bc
7	2Sc / 2Bc	3Sc / 3Bc / 4Sc / 4Bc
8	Concavity on more than 2/3 occlusal surface	

P = Point-like wear facet less than approximately 1 mm in diameter (Figure 1).

L = Linear wear facet less than approximately 1 mm in width (Figure 2).

S = Surface-like wear facet more than approximately 1 mm in diameter (Figure 3).

B = Band-like wear facet more than approximately 1 mm in width or wear facet involving more than two surfaces (Figure 4).

'c'(concavity) means the wear of dentin (Figure 5).

Table 2: Illustration of individual tooth scoring and the highest score selected as tooth wear score

AGE	14	15	16	17	24	25	26	27	34	35	36	37	44	45	46	47	Score
30	0	0	1	0	0	0	0	2	0	0	<u>3</u>	0	0	0	0	1	3
23	<u>1</u>	0	0	0	0	0	0	0	0	0	<u>1</u>	0	0	0	0	<u>1</u>	1
35	1	0	2	1	1	0	1	3	1	0	0	2	0	0	<u>5</u>	<u>5</u>	5
44	2	1	3	6	0	1	<u>7</u>	2	0	0	5	0	0	3	3	1	7
38	1	1	2	<u>4</u>	1	2	<u>4</u>	3	1	1	<u>4</u>	<u>4</u>	0	1	2	<u>4</u>	4
49	1	1	4	6	1	1	4	5	1	1	6	<u>8</u>	1	1	4	<u>8</u>	8
26	0	1	0	0	1	0	0	<u>2</u>	1	0	0	<u>2</u>	0	0	1	0	2
40	1	0	5	<u>6</u>	0	1	<u>6</u>	4	1	0	<u>6</u>	5	1	1	4	5	6

Figure 1: Point-like wear facet less than 1 mm in diameter

Figure 4: Band-like wear facet more than a 1 mm in width

Figure 2: Linear wear facet less than 1 mm in width.

Figure 5: Concavity indicating the wear of dentin

Figure 3: Surface-like wear facet more than 1 mm in diameter

DISCUSSION

As each day passes in life, human becomes older and older showing many regressive changes, but many of the people don't even know their exact age. So in certain instances like identifying a person in forensic cases, judicial punishments, age based eligibilities for job purposes age evidence may be demanded.⁷ Among the most reliable tools in the process of identity of age, teeth is one of them.¹⁰

Teeth known to be the hardest structures of the body can be preserved for longer periods of time and in mass disasters, it is teeth that are least affected and most durable than any other body parts. This explains the usage of teeth as frequently used tools in age estimation.^{4, 7}

Table 3: Mean values and standard deviations of tooth wear score for each tooth and levels of statistical significance between tooth wear scores of males and females

TOOTH NUMBER	MALES		MALES	
	MEAN	S.D.	MEAN	S.D.
14	0.72	0.456	0.75	0.500
15	0.69	0.655	0.67	0.717
16	2.28	1.468	2.56	1.812
17	3.44	2.945	3.36	2.870
24	0.18	0.389	0.17	0.378
25	0.33	0.737	0.44	0.877
26	1.49	1.805	1.53	1.905
27	1.92	1.628	1.64	1.477
34	0.49	0.556	0.33	0.478
35	1.28	1.849	1.0	1.373
36	1.77	1.926	2.3	2.068
37	0.95	0.605	1.03	0.736
44	0.82	0.790	0.75	0.806
45	0.08	0.270	0.08	0.208
46	2.54	2.594	2.19	2.136
47	4.44	2.989	3.89	2.926

Table 4: Regression analysis of age against tooth wear score for each tooth.

TOOTH NUMBER	a	b	r ²
14	32.412	8.620	0.124
15	29.488	13.596	0.635
16	29.877	3.670	0.267
17	27.890	3.189	0.630
24	38.00	4.231	0.019
25	36.624	5.456	0.143
26	33.048	3.773	0.358
27	33.424	2.972	0.158
34	36.291	5.908	0.071
35	34.679	3.536	0.247
36	31.977	3.333	0.329
37	30.247	8.601	0.244
44	31.392	9.332	0.406
45	38.594	1.739	0.002
46	30.995	3.261	0.445
47	24.490	3.413	0.752

In past populations tooth wear was ubiquitous, intense and progressed rapidly. Also affected the occlusal surfaces and profoundly changed the occlusal plane. These observations when compared with the fact that food has become more refined over

time as have the associated technologies and this means that such physiological and ontogenic occlusal evolution is now virtually impossible. Tooth wear that had remained unchanged since the origin of humanity have undergone profound changes in a

very short space of time.⁶ Occlusal wear correlates the age of an individual as this fact is due to the consistent rate with which teeth erupt.

According to Kim's scoring system, degree of occlusal tooth wear is a method to assess age of an individual. Age estimated should be as accurate as possible since it narrows down the search enabling more efficient and time saving approach.⁸

Kim et al. developed a system of age estimation based on the degree of occlusal wear of premolars and molars. Results of estimated age were within ± 3 years in 42.4% of males and 49.4% of females, within ± 5 years in 61.8% of males and 63.3% of females.⁹

Yun et al. repeated further Kim's scoring system with an excellent reliability and occlusal tooth wear of a positive correlation with age. Estimated age results were ± 5 years of actual ages in male and female subjects.

There have been a number of reports in the field of forensic odontology which have dealt estimating the chronological age in humans, living or dead. Typically, this research has approached age estimation in adults based on the degree of occlusal wear and dentin exposure without involving any invasive procedures resulting in high level of accuracy. Determination of occlusal wear differences in males and females was done that resulted increased tooth wear in males compared to females as agreed also by Seligman DA et al.¹¹

It is well known that masticatory muscles in males are better developed than females thereby exerting stronger bite force resulting in increased tooth wear in males compared to females. It is obvious that as age increases, exposure of teeth to various regressive changes increases by which there is wear of teeth.

The method of scoring examined in previous studies showed a mean age difference between the actual and estimated of 3 years but here in the present study the calculated age was within ± 1.52 years signifying the high level of accuracy. This suggests the reliability of occlusal wear based on Kim's scoring and its significance as an age determinant.

CONCLUSION

Amongst the various age estimation procedures

in forensic odontology, Kim's scoring system is one of the simple and reliable method. Its applicability to wide age and non-invasive procedure makes it more preferable.

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