Diş Kodlama (Numaralandırma) Sistemleri

Tooth Coding (Numbering) Systems

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Özet

Dişler, vücudumuzun en sert, dış etkenlerden en az etkilenen yapılarıdır. Yaşam boyunca çürük, fraktür, yetersiz ağız bakımı ve buna bağlı diş kayıplarına sıklıkla rastlansa da, dişler ölümden sonra az değişime uğrar. Bu özellikleri onlara, adli diş hekimliği ve adli antropoloji (diş antropolojisi) çalışmalarında değer kazandırır. Diş kayıtları, adli diş hekimliği ve adli tıp çalışmalarında felaket kurbanlarının, adli antropoloji çalışmalarında da iskelet kalıntılarının kimliklendirilmesinde sıklıkla kullanılır. Kayıtlarda farklı kayıt sistemlerinin kullanılması karşılaştırmayı zorlaştırmakta, kayıt yapanların bu sistemler hakkında yeterince bilgili olmamaları ise hatalara sebep olmaktadır. Bu makalenin amacı, okuyucuyu dünyada kullanılan çeşitli diş kodlama sistemleri konusunda bilgilendirmektir. Bu amaç doğrultusunda geçmişten günümüze kadar kullanılan diş kayıt sistemleri sistematik olarak gözden geçirildi, özellikleri, farklılıkları ve geçerlilikleri tartışıldı. Adli bilimler ve antropoloji alanındaki tüm diş çalışmalarında bir standardın sağlanması yararlı olacaktır. Kanımızca Uluslararası kodlama sistemi (FDI) kullanılması en kolay sistemdir.

Anahtar Kelimeler: Diş numaralandırma sistemleri, FDI, Standardizasyon

Abstract

Teeth are the hardest structures of our body, and the least affected by external factors. Even though they are affected by cavities, fractures, teeth loss related with insufficient oral hygiene, they do not change a lot after death. These features make them significant in forensic dentistry and forensic anthropology (dental anthropology). Dental records are used in identification of victims in forensic dentistry and forensic medicine studies and in the identification process of skeletal remnants during forensic anthropology studies. The use of different recording systems in dental records makes it harder to compare and it leads to mistakes when people who are making the record are not well informed about the system. The aim of this article is to inform the reader about the different dental coding systems. With this aim in mind, dental recording systems used from past to today are examined systematically and, their features, differences and validations are discussed. It would be useful to achieve a standard in dental studies in the fields of forensic sciences and anthropology. We believe the International coding system (FDI) is the most convenient system.

Key Words: Teeth, Numbering system, FDI, Standardization

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The hardest and the most enduring system of our body are the teeth. Teeth can give us important information about age, gender, dietary habits, culture and, general health, which could be very useful in the identification process.

Teeth are used in postmortem and antemortem studies within the fields of forensic science, forensic dentistry, forensic anthropology, and dental anthropology. It is envisioned to keep dental records within a systematic both in forensic studies and clinical dentistry. The false and unstructured recordings and usage of systems, which are not uncommon, prevents the prolificacy of dental records.[1]

Humans have two types of dentition; deciduous and permanent. Teeth have different functions and thus different morphologic apparitions in both types of dentitions. Teeth that are functioning for cutting, slicing or gnawing and digesting have morphologic features in accordance with these functions. Also, teeth may differ according to the jaw they are in with coronal shapes and root numbers. Another characteristic of teeth is that they are separated as left and right according to the quadrant they belong to. These complex features of teeth have brought out the need to systematically identify each tooth by its type, jaw and the quadrant it belongs to and thus led to the development of dental notation systems.[1-5]

DENTAL NOTATION SYSTEMS

The registration of each tooth by a letter, number or symbol in order to indicate its place in space is called dental notation or formulation of teeth.[2,6,7] There are at least ten dental notation systems used in dentistry and dental anthropology. Three notation systems called Zsigmondy/Palmer, Universal and FDI are used commonly in dental records.[2,6-17] However, interpretation of older dental records is frequently needed in criminal dentistry cases and dental anthropology studies. Therefore, both forensic dentists and dental anthropology researchers need to know notation systems different from those that are commonly used today. Systems used during the last century in line with the requirements are presented below.

1. Zsigmondy Notation System

This is the first notation system to be used, created by Australian dentist Adolph Zsigmondy. In this system, permanent teeth are numbered from the midline to the posterior, from 1 to 8 (1st incisor tooth to 8th molar

tooth), and deciduous teeth are numbered again from midline to the posterior, from I to V and shown with Roman numbers (Figures 1,2).[2,3,6,8]

Figure 1: Zsigmony Notation System of Permanent Teeth

Figure 2: Zsigmony Notation System of Deciduous Teeth

2. Palmer Notation System

This system is a modification of the Zsigmondy system. The jaw is separated into 'quadrants' and the permanent teeth are given numbers betrom to 1 and 32, starting from the last teeth on the upper right jaw. For the notation of deciduous teeth capital letters from A to E are used from midline to the posterior on each quadrant. This system, suggested by Corydon Palmer on 1870 at the tenth meeting of the American Dental Association, was started to be used in 1947 after voting (Figures 3, 4).[2,6-8,10]

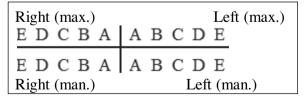*Figure 3:* Palmer Notation System of Permanent Teeth

Figure 4: Palmer Notation System of Deciduous Teeth

3. Haderup Notation System

This system, developed by Victor Haderup in 1887, is commonly used in Scandinavia. In this system, permanent teeth in each quadrant are numbered

from 1 to 8 starting from midline to the posterior. To show the maxillary-mandibular difference '+' and '-' are used, and these signs are put in front or back of the tooth number depending whether it is on the left or the right side. Deciduous teeth are again numbered from 1 to 5 on each quadrant and the number 0 is put in front, '+' and '-' signs are used to show maxillary-mandibular difference and the same signs are put in front of or at the end of the tooth number to show the difference between left and right sides (Figures 5,6).[3,6-8] This system has been used commonly in Scandinavia.

Right (max.)   Left (max.)

| 8+ 7+ 6+ 5+ 4+ 3+ 2+ 1+ | +1 +2 +3 +4 +5 +6 +7 +8 |
| 8- 7- 6- 5- 4- 3- 2- 1- | -1 -2 -3 -4 -5 -6 -7 -8 |

Right (man.)   Left (man.)

Figure 5: Haderup Notation System of Permanent Teeth

Right (max.)   Left (max.)

| 05+ 04+ 03+ 02+ 01+ | +01 +02 +03 +04 +05 |
| 05- 04- 03- 02- 01- | -01 -02 -03 -04 -05 |

Right (man.)   Left (man.)

Figure 6: Haderup Notation System of Deciduous Teeth

4. Universal Numbering System (Cunningham System)

This system, which is used for numbering dental cards has been suggested by Parreidt in 1882 and was started to be used by Cunningham in 1883. In this system, permanent teeth are numbered from 1 to 32 in a clockwise direction starting from the last teeth on upper right jaw. Deciduous teeth are symbolized with letters between A and T, again starting from the last tooth on the upper right quadrant in a clockwise direction (Figures 7,8).[2,3,6-8]

Right (max.)   Left (max.)

| 1 2 3 4 5 6 7 8 | 9 10 11 12 13 14 15 16 |
| 32 31 30 29 28 27 26 25 | 24 23 22 21 20 19 18 17 |

Right (man.)   Left (man.)

Figure 7: Universal Numbering System (Cunningham System) of Permanent Teeth

Right (max.)   Left (max.)

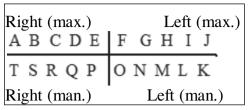| A B C D E | F G H I J |
| T S R Q P | O N M L K |

Right (man.)   Left (man.)

Figure 8: Universal Numbering System (Cunningham System) of Deciduos Teeth

5. The Navy System

This system used in US Navy is a modified version of Universal System. The modification is turning the teeth numbers upside down for mandible. Teeth numbering starts from upper right jaw and continues from lower right in lower jaw. Thus, the upper right 3rd molar is numbered 1, lower left 3rd molar tooth is numbered 32.[3,6,7] Deciduous teeth are symbolized with letters from A to T like in Universal System, but teeth symbols are turned upside down in mandible (Figures 9,10).

Right (max.)   Left (max.)

| 1 2 3 4 5 6 7 8 | 9 10 11 12 13 14 15 16 |
| 17 18 19 20 21 22 23 24 | 25 26 27 28 29 30 31 32 |

Right (man.)   Left (man.)

Figure 9: The Navy System of Permanent Teeth

Right (max.)   Left (max.)

| A B C D E | F G H I J |
| K L M N O | P Q R S T |

Right (man.)   Left (man.)

Figure 10: The Navy System of Deciduous Teeth

6. Modified Numbering (Netherlands) System I

In this system, teeth are shown by the initial letters of the names that they got according to their function. (Capital Latin letters if permanent, lower letter if deciduous teeth). These letters get the additional letter 'd' (dexter) if on the left side of the jaw or 's' (sinister) if on the right side of the jaw and also 's' (superior) if on the upper jaw and 'i' if found on the lower jaw (Figures 11,12).[18]

Right (max.)   Left (max.)

| M3sd M2sd M1sd P2sd P1sd Csd I2sd I1sd | I1ss I2ss Css P2ss P1ss M1ss M2ss M3ss |
| M3id M2id M1sid P2id P1id Cid I2id I1id | I1is I2is Cis P2is P1is M1is M2is M3is |

Right (man.)   Left (man.)

Figure 11: Modified Numbering (Netherlands) System I of Permanent Teeth

Right (max.)									
m2sd	m1sd	csd	i2sd	i1sd	i1ss	i2ss	css	m1ss	m2ss
m2id	m1id	cid	i2id	i1id	i1is	i2is	cis	m1is	m2is
Right (man.)								Left (man.)	

Figure 12: Modified Numbering (Netherlands) System I of Deciduous Teeth

7. Modified Numbering System II

In this system, permanent and deciduous teeth are shown with the initial letter of their names in Latin. It is coded such as; Permanent middle upper incisor tooth: DIPMS (Dens Incisivus Permanent Medialis Superior) and deciduous maxillary clutrol incisor tooth: DIDMS (Dens Incisivus Deciduous Medialis Superior). The letter X is put on the right or the left side of the symbol in order to indicate whether the tooth belongs to right side or left side of the jaw (Figures 13,14).[10]

Right (max.)															
XMMP3S	XMMP2S	XMMP1S	XDPP2S	XDPP1S	XDCPS	XDIPLS	XDIPMS	DIPMSX	DIPLSX	DCPSX	DPP1SX	DPP2SX	MMP1SX	MMP2SX	MMP3SX
XMMP3I	XMMP2I	XMMP1I	XDPP2I	XDPP1I	XDCPI	XDIPLI	XDIPMI	DIPMIX	DIPLIX	DCPIX	DPP1IX	DPP2IX	MMP1IX	MMP2IX	MMP3IX
Right (man.)														Left (man.)	

Figure 13: Modified Numbering System II of Permanent Teeth

XMMD2S	XMMD1S	XDPD2S	XDPD1S	XDCDS	XDIDLS	XDIDMS	DIDMSX	DIDLSX	DCDSX	DPD1SX	DPD2SX	MMD1SX	MMD2SX		
XMMD2I	XMMD1I	XDPD2I	XDPD1I	XDCDI	XDIDLI	XDIDMI	DIDMIX	DIDLIX	DCDIX	DPD1IX	DPD2IX	MMD1IX	MMD2IX		
Right (man.)											Left (man.)				

Figure 14: Modified Numbering System II of Deciduous Teeth

8. Bosworth Numbering System

In this system, maxillary teeth are shown with numbers while mandibular teeth are shown by Latin letters.[6] Maxillary permanent teeth are numbered from 1 to 8 starting from middle line to the back for each side of the jaw. Mandibular permanent teeth are shown by letters from A to H starting from the middle line to the back on each side of the jaw (Figures 15,16).

Right (max.)															Left (max.)
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
H	G	F	E	D	C	B	A	A	B	C	D	E	F	G	H
Right (man.)															Left (man.)

Figure 15: Bosworth Numbering System of Permanent Teeth

Right (max.)										Left (max.)
D5	D4	D3	D2	D1	D1	D2	D3	D4	D5	
DE	DD	DC	DB	DA	DA	DB	DC	DD	DE	
Right (man.)									Left (man.)	

Figure 16: Bosworth Numbering System of Deciduous Teeth

9. Anthropologic (South Africa) Numbering System

Although there is no title in literature indicating the teeth numbering systems in anthropology, it can be observed that the numbering systems used in anthropology are different from the ones used in dentistry. In this system, permanent teeth are shown by the initial letter of their names in upper case. In order to indicate upper/lower and left/right sides of jaw, numbers are written in the upper/lower/left/right sides of their names (Figures 17, 18, 19, 20).[8,13,18]

Right (max.)															Left (max.)
M^3	M^2	M^1	P^2	P^1	C	I^2	I^1	I^1	I^2	C	P^1	P^2	M^1	M^2	M^3
M_3	M_2	M_1	P_2	P_1	C	I_2	I_1	I_1	I_2	C	P_1	P_2	M_1	M_2	M_3
Right (man.)															Left (man.)

Figure 17: Anthropologic (South Africa) Numbering System of Permanent Teeth

Right (max.)															Left (max.)
M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	1P	2P	1M	2M	3M
M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	1P	2P	1M	2M	3M
Right (man.)															Left (man.)

Figure 18: Anthropologic (South Africa) Numbering System of Permanent Teeth

Right (max.)										Left (max.)
m^2	m^1	c	i^2	i^1	i^1	i^2	c	m^1	m^2	
m_2	m_1	c	i_2	i_1	1_1	2_1	c	m_1	m_2	
Right (man.)									Left (man.)	

Figure 19: Anthropologic (South Africa) Numbering System of Deciduous Teeth

Right (max.)				Left (max.)			
m2 m1 c ı2 ı1	ı1 ı2 c 1m 2m
m2 m1 c ı2 ı1	ı1 ı2 c 1m 2m
Right (man.)				Left (man.)			

Figure 20: Anthropologic (South Africa) Numbering System of Deciduous Teeth

10. FDI (International Federation of Dentistry) Notation system

This system, which was suggested in 1971 in a meeting of the International Federation of Dentistry was started to be used in 1987 after being accepted in an international congress. In this notation, upper and lower jaw are separated in to quadrants and for each side of the jaw teeth numbers have been written starting from the middle line. In order to indicate whether teeth is on the right or the left side, numbers starting from 1 to 4 in permanent teeth, and from 5 to 8 in deciduous teeth have been added, starting from upper right quadrant of the jaw (2, 3, 6,7, 8, 10, 11, 15, 17,19) (Figures 21, 22).[2,3,6-8,10,11,15,17,19]

Right (max.)							Left (max.)							
18 17 16 15 14 13 12 11	21 22 23 24 25 26 27 28
48 47 46 45 44 43 42 41	31 32 33 34 35 36 37 38
Right (man.)							Left (man.)							

Figure 21: FDI (International Federation of Dentistry) Notation system of Permanent Teeth

Right (max.)					Left (max.)				
55 54 53 52 51	61 62 63 64 65
85 84 83 82 81	71 72 73 74 75
Right (man.)					Left (man.)				

Figure 22: FDI (International Federation of Dentistry) Notation system of Deciduous Teeth

DISCUSSION AND CONCLUSION

Teeth notation systems that started to be developed at 19th century with the need to indicate where the tooth is located in the mouth, have not been standardized yet. It was observed that using the Latin names for each tooth is not indicative enough and thus, new methods were needed.

The major hassle this system created was observed expressing incisive, premolar and molar teeth with Latin letters. Human beings have 2 incisive, 2 premolar

and 3 molar teeth on each side of the jaw, thus it was hard to understand to which side of the jaw the teeth belonged and which number they were, when the teeth were symbolized only with Latin letters.[10] The impracticality of the system accelerated the research and in 1861 the tooth notation system created by Zsigmondy was started to be used.[8,10] The method created by Zsigmondy was later modified by Corydon Palmer, a dentist from Ohio, and was brought to use. The difference between these two systems is that one uses Roman numbers to indicate deciduous teeth while the other uses capital Latin letters. However, the usage of a quadrant for differentiating between lower, upper, left and right jaw in both these systems created some difficulties as it is not suitable for using and saving in electronic media.[8,9] Against all the criticism, the Palmer system was accepted by American Dental Association in 1947 and stayed in use in until 1959. After this date, the American Dental Association started using the Universal Numbering system. The Universal Numbering system seems to be the easiest to use. However, it received criticism over the fact that it indicates permanent teeth with Arabic numbers from 1 to 32 and deciduous teeth with Latin letters from A to T, mentioning that it can cause problems in indicating a specific tooth.[6]

In the Bosworth notation system, numbers are used to indicate upper jaw teeth and letters for lower jaw teeth. The greatest disadvantage of this system is that it makes it necessary to use a horizontal line to separate left and right side teeth.[6]

Even though the FDI notation system was accepted as standard at the meeting held in 1971 by International Federation of Dentistry, the standardization was not successful.[11] In a research based on 37 countries, it was noted that the FDI system is being used only in 18 countries.[2,9]

FDI notation system is the most detailed, practical to use, the easiest to use within electronic media and the most effective amongst the systems that was reviewed.[6,10,13,17] However, Universal system users claimed that the indication of teeth by numbers can cause confusion and they proposed a modification. For instance; the tooth shown by number 11 in FDI notation system is upper right incisor, the same number in Universal system indicates the upper left canine (Figure 3, 21). In order to prevent confusion, Sharma and Wadhwa[17] suggested to indicate the whole numbers used in the FDI system separately. The modification suggested for the FDI system is to read 15 teeth in the Universal system as they are (maxillary second left molar, maxillary second right premolar

in FDI system) and to read and write them from 1 - 5 in the FDI system.[6,10] Still, this suggestion has no validation in practice.

Another significant reason the FDI system should be used today is that, this is the notation system that is being used in the disaster victim identification (DVI) forms.[6,10,19,20] The standardization of tooth numbering systems is very important for Turkey, which is a country based over a seismic belt. Studies made by DVI teams around the world shows that keeping tooth records makes identification easier and they are highly reliable information sources.[6,7,19,20] In DVI studies based on post mortem and ante mortem, the usage of different notation systems aggravates positive identification.[6,13] Similarly, different notation systems used in dental anthropology causes problems in comparing dental pathoses and variations.[3,10] Since the FDI notation systems allows the information to be recorded on computer database fast and easy, it is envisioned to be used actively in anthropology studies, especially in dental examinations belonging to big collections.[10] The authors of this article believe that it is important to use common terminology in order to develop dialogue between disciplines in the area of forensic sciences which is a multi-disciplinary field of study. Although the tooth coding systems are developed through continuous modifications, few problems still exist in teeth identification. The most significant problem is that a consensus has not been reached yet over defining supernumerary teeth and teeth with anomalies. Toureno et al.[21], underlines the necessity of coding the supernumerary teeth with signs according to their location and shape, then writing the determined codes next to the teeth numbers to identify supernumerary teeth. Another suggestion to solve the problem has been developed by Yadav et al[22]. They suggest that describing teeth with anomalies and supernumerary teeth by letter signs can be useful. The examples of the coding system suggested in the study

are: paramolar tooth, dm: distomolar tooth, f: fused tooth, g: geminated tooth, m: mesiodent.

Developing teeth coding systems is important in terms of preparing the teeth registries correctly and in a short time. Teeth records are important data sources for the identification of disaster victims and in malpractice cases. Especially for the identification in DVI studies not only data about crown but also data about root anomalies should be recorded. Thus, the authors of this article believe it is necessary to have explanatory fields in electronic registry systems and teeth anomalies should be registered. In our country, the FDI system has been used in various studies in the fields of forensic sciences and anthropology.[23] Also oral health centers of Ministry of Health use the FDI teeth notation system. Anyhow, standardization is still not achieved country wide. Data showing how effective the common used FDI system are lacked. In line with this objective, a further research is needed indicating how effective is the FDI system commonly used in oral health centers.

Scientific progress has made privatization in various fields necessary. Standard or similar methods should be used to share the produced information. If standardization could not be met or the standard system is not used effectively, the information gathered may not meet the requirements. The usage of different systems may lead to useless information gathering and stocking and waste of source and work. Indeed this is not a local problem. A worldwide standardization is also needed because of the larger scale of means of transportation we have today, such as immigration. In order to minimize the possibility of mistakes and to solve current problems, a standard should be met both locally and globally over the issue of teeth notation systems. In addition, researchers working in the fields of forensic dentistry and dental anthropology should be encouraged to use a common notation system.

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