Harris Lines: The Indicators of Physiologic Stresses in Pathology of Human Skeletal Remains (According to the Founded Samples in Iran)

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Abstract

To complete the archaeo-anthropological reports, especially the ones related to the environmental, economic and population status of ancient regions, one of the most significant methods of studying the human skeletal remains is pathology. Skeletal remains pathology makes it possible for the scientists, especially bio-cultural anthropologists, to have an access to the main important information about the former population, as far as ecology is concerned, diet, life style, growth, demography and hygiene of the societies under the study. Doubtlessly, with the help of the technological advancements, such as radiography, skeletal diseases like "Harris lines" could be easily diagnosed. Furthermore, using this technique, results in unknown responses of skeletal to malady. The present article tries to describe the importance of the new method of studies on human skeletal remains for better understanding of the literature and analyze such diseases from archeoanthropological perspective.

Keywords: Harris lines, skeletal pathology, bio-cultural anthropology

Introduction

Since the discovery of X-ray, which has simplified the recognition of different stress symptoms in living creatures and skeletal remnants, the consideration for the signs and effects of natural bone has greatly increased. X-ray is one of the most important devices for a pathologist. This technique has priority to chemical and histological methods. In the ancient pathology, the main goal of radiography is studying the unknown bone responses (like Harris lines) to a disease. The transmitting lines of the radiography, which exist at the end of the growing part of long bones and the crown of teeth, have been typically called "Harris lines" since being discovered by Harris (1933, 1931, 1926). These lines are also known as "intersectional transmitting fibers" (Path and Stewart, 1962), "transmitting lines" (Park and Richter, 1953), "radiographic transmitting lines" (Harris, 1993),and "excess lines and fibers to prevent from x-radiation transmission" (Garn, et al, 1968). It seems as if these lines are formed while recovering, after the disease is healed. For the infants and children, who have been suffering from the disease for a long time, these lines come into being as a result of several metabolic attacks.

Harris lines record the growth halts resulted from long-bone epiphyses during the childhood. Some decades ago, the works of some specialists such as Park, Richter, Garn, Steinbeck, Harris and Folis proved a mechanism which demonstrated cartilage cells and infected osteoplastyese, and also created Calcium deposits.

Harris lines formation could be proved by some events related to the growth halts at the parts where constant cartilage cells division, which allows the mineralization to continue, is reduced or stopped. When growth is reinitiated, long-bone cartilage plates have linear movement and produce extra mineralized loops which prevent from X-radiation transmission. There is no doubt that these lines do not grow simply for the sake of coming into existence in solitude; on the contrary, they are the recovery signs for the disease and leave their effects on the bone (Walimbe and Gambhir, 1990).

II. The classification of the bone diseases

The most important bone diseases which skeletal pathology (bio-cultural anthropology) has a great emphasis on are as follows (Fig.1):

1. Bone Inflammation, including:
   - 1.1. Osteitis and Periestitis
   - 1.2. Osteomyelitis
   - 1.3. Tuberculosis
   - 1.4. Leprosy
   - 1.5. Syphilitic
   - 1.6. Yaws
2. Tumours
3. Diseases of joins, including:
   - 3.1. Arthritis
   - 3.2. Osteo-Arthritis
4. Dental and Jaw Pathologies
   - 4.1. Caries
   - 4.2. Periodental disease
   - 4.3. Chronic abscesses
   - 4.4. Hypoplasia
   - 4.5. Cysts
   - 4.6. Dental Tumour/ Adontomes
5. Deformities, including:
   - 5.1. Infantile paralysis or Poliomyelitis
   - 5.2. Hip deformities and Congenital Dysplasia of the Hip
6. Endocrine disturbances, including:
   - 6.1. Hyperituitarism, which ends in two kinds of disease;
     - 6.1.1. Gigantism
     - 6.1.2. Acromegaly and Dwarfism
7. Diet Effect on Bone, including:
   - 7.1. Rickets, as a result of food shortage, lack of Vitamins C and D
8. Ostemalacia
9. Metopism (Tavassoli, 2000)
10. General stress, including:
    - 10.1. Harris lines
    - 10.2. Enamel Hypopllasias (zivanovic, 1982, 83)

Fig. I: TEH CLASSIFICATION OF BONE DISEASES		
1) Bone inflammation	***4) Dental and jaw pathologies***	**7) *The effect of diet on bones***
•Bone inflammation and Periestitis • Osteomyelitis • Tuberculous • Leptosy • Syphilitic • Yaws	• Caries • Chronic abscesses • Hypoplasia • Dental tumour	• Rickets • Osteomalacia
2) Tumor	***5) Deformities***	8) ***Metopism***
	•Infant paralysis or poliomyelitis • Hip deformities and congenital dysplasia of the hip	
3) *Disease of joints*	***6) Endocrine disturbances***	**9) *General stress***
• Arthritis • Osteo-arthritis	Hyperituitarism Gigantism Acromegaly Dwarfism	• Harris lines • Enamel hypoplasias

III. The Demography of Human Populations

In the course of Iranian ancient excavations, the discovered human skeletal remnants provide very little amount of certainty regarding the studied population samples. Unfortunately, very few studies have been carried out about the human remnants which date back to the pre-agricultural era in Iran. Majority of the researchers who have excavated in Iran have only recorded some brief reports about the discovered human skeletons and remaining bones. No extensive organized attempt has been made with the aim of clarifying the location of the excavated regions where scientific analysis of bones could be done. In 1973, scientists have analyzed and studied the Neolithic societies of South Western Asia (between 5000-9000 A.D.) regarding pathology and Harris lines (Oates, 1973).

Oates (1973) also studied some societies and communities around Zagros and Mesopotamia. Furthermore, Voight (1977) reported some specific interesting details about valley-like regions in Iran. Two famous western archeologists, Holl and Flannery, accompanied with a group of their colleagues, explored and excavated the western part of Iran, especially Dehloran region between the years 1969-77 (Rathbun, 1981 p.266 & 1984 p.137-167). Although many graves have been reported, a thorough document is not accessible yet. In the reports, there have been some indications to the pathology of bones , no concern has been given to the size and details of the samples under the study, though. Considering the existing reports, according to the skeletal and bone remnants, the population growth and density of the region is, to some extent, predictable. However, the population spread could only be estimated by some factors such as the area of the study, houses' dispersal, and the analysis of ethnographical methods.

Although a considerable issue about anthropology exists due to the analysis of ex-population demography, the basis of documents in Iran seems to be insufficient for making a comparison with the current situation. Sampling problems, disorganized scientific excavations, and piecemeal bones analysis all result in demographic weaknesses in Iran. It seems as if the lack of middle-age skeletons among the collected samples is probably because of the frangibility of younger bones. Archeological reports usually represent good and bad events and periods. It seems that the babies and children's death has been too much in the era when the study was carried out. In the reports related to the Neolithic era and the periods after the metal era, this incident has been more common(Rathbun and Bass, 1977, p.55-61). Unfortunately, because of sufficient particular age classification documents, a systematic comparison of demographic features of both dead and living populations has been prevented.

IV. Growth and development

With the help of anthropology analysis and accurate measurement of long bones length and food distribution among different classes of a society, the nutrition and life style and economic status of human populations could be figured out. Harris lines can well demonstrate the growth disturbance and its recovery in the course of growing among some populations. These lines have been witnessed in some skeletal populations of some regions related to the Neolithic era and the periods afterwards; however, not all of the samples have been radio graphed, unfortunately. This method proves that all the samples are of the same condition. The remained bones from the Neolithic era, gathered from Ganj Dareh region in the western part of Iran, has almost continued ten percent of Harris lines (Meiklejohn, 1980, p.255) while in Sagabi region, sixty-nine percent of children in Chalcothic period (Skinner, 1980, p.280) and ninty-two percent of adults in Dinkhah Tapeh region in Bronze and Iron periods (Rathbun, 1981, p.266) have demonstrated these lines.

By the passage of time, these lines have increased more relatively in the other regions. According to the research samples, the bones which belong to the Bronze era have more lines than the ones related to the Iron era, in particular in men. These lines formation's age almost varies. For instance, these lines have appeared after the childhood in the youngsters of Bronze era while in Iron era, they have been seen in the early childhood. In Dinkhah Tapeh region in Iron era, thanks to the shared studies about Harris lines, especially the short length of tooth crown, the general situation has been well demonstrated. Harris lines formation usually occurs between the ages of seven to eleven; nevertheless, periodic stresses could be seen all through the growing years. The disease and the formation of these lines could be resulted from seasonal food shortage or constant malnutrition.

The relative low level of Harris lines among the primitive Neolithic groups could also be due to the disappearance of stress in people at a younger age. Thus, from this respect, this group should be separated from the aged sample and studied separately. Anyway, it is necessary to point out that seventy-one percent of the babies born in Sagabi region are the best data for studying the skeletal diseases in Iran(Skinner, 1980, p. 281).

V. Food shortage (Malnutrition)

Bone diseases (Porotic Hyperostosis) which are resulted from the lack of vitamin have been reported in the Neolithic populations of the Western part of Iran, like the too many samples in Europe (Putschar, 1981, p.230). Unfortunately, these reports have not clarified whether there have only been optical wounds or skull changes have also been witnessed. Furthermore, no theory or suggestion has been mentioned about genetic anemia in the reports. Consequently, this thought remains that damages demonstrate the lack of iron in the food consumed. No optical disease was recorded in Ganj Dareh; however, twenty-eight percent of children in Sagab suffer from optical damages. Though, there are questions regarding the different diseases' diagnosis and the importance of the wounds.

In skeletal groups of Iron era in Iran's plateau and Mesopotamia, the average of people's optical diseases has been reported to be twenty-three percent (Rathbun, 1980, p.269). In the documents related to the men and women of skeletal populations, with the purpose of reaching a conclusion about the optical damages, no regional difference has been seen. In many reports, there is no difference between skull bone hollow, general hollow, and the bone disease which are due to the vitamins D and C and iron deficiencies and Diploe, as well. In Haji Firouz, dental decay has been reported. It is inferred that the disease between the two sided surfaces (interpromixal) in the joint of the crown's root is very common, while there is no such inference about the tooth crown diseases since it seems as if both older groups of dental decay have led to some doubts about the tooth crown's decay.

Abe alveolar, a kind of dental disease, with cavity diseases and periodentoclasia at a joint have not been reported among the human skeletal remnants in Iran. The above-mentioned disease usually appears around the tooth as a severe remained cavity. The time and quantity of the incomplete growth formation of tooth crown's linear tissue have only been investigated lately; therefore, no complete data is accessible among the skeletal samples. Moreover, it is not clear yet whether the skeletal samples had the same condition before the Neolithic of Hotu. Only six percent of the Neolithic skeletal population in Ganji Dareh has presented these lines (Meikelojohn, 1980) . Although forty-five percent of Neolithic children in Sagb had this sign of stress, fourteen percent of the children of Iron Age had this disease. It is not known what factors have caused this stress reduction; as a result, these factors should be carefully found and analyzed, and more light should be shed on this issue.

The further studies, which were carried out by Ruth bun in 1981 on the skeletal remnants which belonged to Bronze and Iron Ages in Dinkhah Tapeh, demonstrated that almost seventy-seven percent of the studied samples had Harris lines and incomplete tooth-crown tissue growth (Table 1).

VI. Conclusion

As a result of the lack of data, according to the very few studies and documents, a clear image of health, disease and life changes of Iranian society could not be provided. Although there are deep gaps in the course of the accessible skeletal populations history, another systematic study of available samples existing in museums and other such places, with a great emphasis on skeletal pathology and Harris lines, should be prior to the future anthropology researches in Iran. The new research plan should not only include the diagnosis of a disease with the help of the visual evidence, but also use new radiography, chemical and microscopic methods. Although it is very efficient to have several aims for this investigation, more attention should be paid to the dating and data gathering methods. The problems of archeological data and provision of the obtained samples from the past excavations have still remained. The new study of the extensive collections should be carefully done by new skills. No matter how limited these collections are, they can provide new and important information about the skeletal populations. The small size of some samples for some periods, broken skeletons, lack of skeletal heads and lack of specialists to protect them are the most serious restrictions of the existing collections. Some other problems such as lack of advanced technological devices and studying equipments in laboratories and most importantly lack of specialists in pathology should be added to the list of the limitations.

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Table I: The Diagram of Studies in Pathology of Human Skeletal Remains
(According to the available findings from ancient sites in Iran)

Hotu Cave	58000	3	Angel	1952	
Tamtameh	40000	1	(not studied)		
Beestoon	35000	1	(not studied)		
Ali kash	9000	36	(not studied)		
Kamarband Cave	8500	6	Angel	1952	Only skulls
Ganj Darreh	8500	49	Meikeljohn and Lambert	1980	41 skeletal remained
Dehloran	8000	45	(not studied)		
Chogha Sefid	6300	8	(not studied)		
Tapeh Gooran	6000	4	(not studied)		
Dalma Tapeh	6000	46	(not studied)		
Tapeh Sabz	6000	5	(not studied)		
Dasht-i-Qazvin	6000	Unknown	Tavassoli	1993	Only 11 samples
Haji Firouz	5400	30	Voight	1983	
Sialk 1,2 and 3	5000	16	Vallois	1938	Without pathology
Hassanloo	5000	7	Rathbun	1972	Only
Sagabi	4100	30	Skinner	1980	pathalogy
Sialk 4	4000	3	Valliois	1938	Only skulls
Hesar 1,2 ,3	2000-4000	158	Korgman	1940	
Goy Tapeh	3000	7	Cave and Centeno	1951	
Shahr-i-Sokhte	2000-2900	147	Pardini	1977	Only 58 samples
Shah Tapeh	2000	32	Furst	1939	Without pathology
Tapeh Gian	2000	5	Vallois	1935	
Dinkhah Tapeh	1900	13	Rathbun	1983	
Tapeh Daylaman	900	78	Ikeda	1968	
Takht-i-Solyman	450	29	Storm	1976	