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Roopkund Human Skeletal Remains
'A short Note on the Signs of Nutritional Stress and Anemia on the Cranial and Orbital surface'

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Abstract

This paper is going to investigate the relation of porotic pathology and health status of the Roopkund victims. All the skeletal material like skull, vault and other major part of cranial bones, total 27 samples are collected personally from the lake site during the years 2004-2007 in total 6 visits. All collected remains have been examined under the pathological and osteological methodology for skeletal remains. Mainly basic methods and non metric analysis are used to understand, health status and personal information's of the victims. All identified porotic skull pathologies are categories in the term of porotic hyperostosis and cribra orbitalia and the severity of the pathological findings are graded as per the grading system for the specific problem. Observed pathologies are neatly displaced in the result section. All identified problems and the expected cause or causes of the problem discussed and explained one by one in discussion and final comment for health status of the victims at the conclusion section.

Introduction:

Roopkund is a small sized beautiful glacial lake, situated on the upper Himalayan region in Chamoli, Uttarakhand, India, at the altitude of 5029 M. The lake is surrounded by the beautiful peaks of Nanda Ghungti and Trishul Massif from the north eastern side. The area is uninhabited and evens the last village of the valley named Wan, is more than 30 km far from the lake and it takes 3 days by walk to reach the base camp. Weather conditions of the area are too sensitive and vary with the altitude. Lake is covered with snow for about 10 months in a year. Only August and September months are appropriate for tourist visits. Many rare Himalayan flowers like *Saussurea obvallata, Saussurea simpsoniana, Saussurea piptathera, Saussurea gosifipora, Cryptogramma crispa, Rihum* etc are usually seen here during this session. Roopkund has a religious importance among the locals and in the past it was known as the 'Rudrakund', but discovery of human skeletal remains at the lake side in 1942, gave it international fame and sometimes named as **Mystery Lake**, **Skeletal Lake** by the people.

Firstly, the glacial lake was noticed by the British investigator in the year 1898. In 1907, Longstuff also mentioned about these skeletal remains in his Trishul expedition. This discovery has revolutionized the world of ancient history ever since 1942, when a Forest officer Mr. Madhwal and Scottish Lt. Hamilton came across this mass deposition of bones. In 1955 Madhwal repeated his visit to Roopkund with former Forest State Minister Mr. Jagmohan Singh Negi, and then the racial and historical investigation of Roopkund remains get started. Nobody knows that why and how these people had been reached here and what happened to them? After the discovery of these remains, numbers of expedition and investigations to know the personal identity, origin of these people and cause of this mass casualty has been conducted by the different national institutions but none of them put full-stop on the reason of the mysterious remains presence at this beautiful Himalayan Lake (Anthropological Survey of India (1959), Lucknow University (1958) and National Geography Channel (2005). There are many stories related to these remains and we can divide them as religious or historic believe and scientific for our convenience. The religious beliefs associate these Roopkund remains with the Kannoj king Yasdhawal, Queen Balampa and their attendants (Swami Pranwanand 1959). Though there is no any written evidence available about Roopkund mystery in the history, yet some people did research to place it in the historic era. Such as, these remains are belongs to an army, self suicide, self sacrifice and local epidemic victims (Yamuna Dutt Vaisnav, 2000). But without any written evidences these are consider only assumption. Scientific investigation such as Osteomitric, Carbon Dating, A-B-O blood group investigation has been conducted by the Anthropological Survey of India 1956 (), Department of Anthropology, Lucknow University (1956) and National Geography Channel (2005). Recently Niraj Rai et al. (2019) used advanced genetic and carbon dating technique to unrevealed the mystery.

Fig .1. view of Roopkund lake ,

Fig. 2, 3,4 route map of Roopkund

Objectives

The main objective of this study is to describe the demographic profile and identification of pathological features of the remains. Categorization of the identified pathologies according to respective cause and causes is the other major aim of the study to identify the serious health issues and probable cause behind the majority of deaths.

Preservation and Taphonomy

Though, high altitude and glacial topography of Roopkund Lake well preserved all the skeletal remains with skin. But, frequent landslides broke and scattered them all around the

lack. Some bones are showing discoloration due to sunlight exposure. Roopkund remain assemblage has approximate 200 individuals. But it is very hard to guess exact number and work on the whole assemblage. Skull remains are highly damaged and present in large (crania, vault) and small fragments. For this study we find only one complete skull.

Fig 5, scattered human remain on the slop of Roopkund lake

Material and Method:

For this study all the skeletal material has been personally collected from the site through more than 6 visits during the years 2004 to 2007. Mainly random collection method has been used for remains collection because the geographical toughness and ecological sensitivity doesn't allow digging at the site. Therefore, in this situation only surface material was the only choice for remains collection. The skeletal assemblage has total 27 skull samples including skulls, cranium and vault and small skull fragments. Selection of the samples was also not less than a puzzle for the researcher because due to continuous landslide and human intervention all the remains were scattered and mixed together. Therefore, it is difficult to say whether remains found together belong to same individual or another. After collection and bringing them to the laboratory, collected specimens have been cleaned by the normal water and dried up in the shade. Then all related fragments have been fixed up with the associated skull or part of the bone with the help of adhesive. At that time, certain skull fragments not attached to the skull or bone, as a part of which they were collected. Rather, they were representing other individuals. For the analysis of the Roopkund remains methodology selection was an important part to accomplish the objectives. Craniometric observations are possible for only two specimens. Craniometric observations are recorded using method given by Martin and Saller (1957) with the help of spreading caliper and sliding caliper. All measurements are given in millimeters. There were, instances, when exact measurement could not be taken than in such cases the measurements are given in bracket to indicate that they are estimated.

With strict adherence to the above mentioned methodology, skeletal remains are subjected to careful laboratory analysis. To create the demographic profile of the Roopkund remains Age and sex for personal identity has been conducted using the methods suggested by Bass (1981) and Ubelaker and Buikstra (1994).

Most of the skulls remains didn't have any facial portion, so, cranial suture closure method (Borthwell (1981), Olivier (1969), Stewart (1979), Bass (1981) and Ubelaker and Buikstra

(1994) has been used for individual's age estimation. But as we know that the suture closure rate is varied from person to person and affects the age estimation. So, to rectify this problem and accurate age determination has been done by the examination of sutural closure rate, texture/morphology and robustness, fusion of basi-occipital to basi sphenoid and extension of sphenoid sinus into occipital bone. An estimated age has been categorized into Young adult (20-34 years), Middle age adult (35-49 years) and Old adult (50+years).

Sex determination of the individuals has been determined under the non-metric observation methods and parameter suggested for the skull features by Borthwell (1981), Olivier (1969), Stewart (1979) and Ubelaker and Buikstra (1994). Features such as nuctal crest, mastoid process, supra-orbital margin, prominence of glabella, slope of forehead, and prominence of temporal line have been examined for the sex determination of the remains.

Paleopathology deals with the skeletal pathologies and anomalies in the light of ecology, environment changes, subsistence pattern and social organization giving bio-cultural perspective. For this study, Pathological examination has been conducted to observe individual's health status under the guidelines of Ubelaker and Buikstra (1994) and GHP (Global Health Project). The severities of the pathological findings are graded as per the international grading system for the problem. Observed pathologies are categorized as follows:

1. Infections disease,
2. Traumatic lesion,
3. Morphological changes
4. Porosity,
5. Anomalies

Observations

Roopkund remains show a vast range of age distribution from young adult to old aged people. There is, within 27 samples, 1 individual (3.7%) have been found confirmed young adult (20-35) , 10 individuals (37.3%) belonged to middle age (35-49) and 6 individuals (22.2%) to old aged (50+) and another 6 individuals (22.2%) found belong to adult age group. There are 4 specimens (14.8%) whoever not appropriate for age estimation.

Categorized Age group of the remains	**No. of sample out of 27 sample**	**Average % of total estimated age samples**
Young adult (20-35 year)	01	3.7%
Middle aged adult (35-49 year)	10	37.03%
Old aged adult (50+)	6	22.2%
Adult	6	22.2%
Not estimated	4	14.81%
Total	**27**	**100%**

Table: 1, Estimated Age Distribution of Roopkund Remains

Sex determination through skull and skull fragments was really a tough task in this study. Among 27 (skull, crania) 1 male (3.7%) confirmed, 4 probably male (14.9%), 1 female (3.7%) confirmed, 5 probably female (18.5%) and 16 remains (59.5%) wasn't helpful for sex estimation. It is noticeable that only two specimens have maximum features for observation.

Diagnosed sex	No. of sample from 27 sample	Average % of total diagnosed samples
Male (confirmed)	01	3.7%
Male (probable)	04	14.9%.
Total	05	18.6%
Female (confirmed)	01	3.7%
Female (probable)	05	18.5%
Total	06	22.2%
Undiagnosed	16	59.5%
Total	16	59.5%

Grand total	27	100%

Table: 2- Identified Sex Distribution of Roopkund Remains

Pathology

There are more than 20 out of 27 skull samples having porotic pathological findings in form of hyperostosis and cribra orbitalia. All the pathologies have been observed with naked eyes. Here, 16 individual's found porosity on outer surface of crania alongside of sagittal suture on the parietal bone near vertex. In some remains, porosity has been found on the frontal bone above the supra orbital ridge and occipital bone just above the external occipital protuberance. Inner cranial surface pitting kind porosity has also been found in XIV as well. Here, one thing is very interesting that in some individual's the porosity observed very compact and in some others it is very light. Pitting or macro porosity also observed at the supra orbital region in one specimen. The severity of the porosity is graded 3 in 9 samples, 2 in 5 samples and 1 in 2 samples. Porotic hyperostosis along with saggital suture on both partial bones seems sever and graded as 3 out of 5. Woven kind of formation has been observed on Inner wall of occipital bone of individual XIX.

Porosity in form of Cribra orbitalia has also been observed at the orbital wall of the individual RCA III, RCA V and RCA XXIV. In individual XXIV the porosity is present in form of pitting. Individual III and V have micro porosity on the orbital wall. The severity of the porosity is graded as 1-3.

Fig. 6, 7, 9, porosity alongside of sagittal suture, parietal bone and occipital bone (hyperostosis)

Fig. 8, 10 porosity and woven formations on the inner surface of occipital bone

Fig. 11,12,13 porosity on the orbital wall (Cribra Orbitalia)

Discussion

Pathological observation disclosed severe porosity on the most of the skull remains especially alongside the sagittal suture on the parietal bone near the vertex area. This kind of porosity definitely appears when person is suffering from anemia (Iron and Vitamin C, D deficiency). Anemia always occurred due to long lack of required nutrition like Iron, vitamin C and D, probably intake of lesser amount of fresh food and proper sunlight (Roberts).

Cribra orbitalia is again the result of severe anemia (Iron and Vitamin C, D) (Ortner Donald j. 1975; Aufderheide A.C., C. Rodriguez Martin, 1998; Marc Fredrick Ivor Cavill 2010; Sarunas Jatautis, Ieva Mitokaite, Rimantas Jankauskas, 2011). Roopkund is located at the altitude of more than 5000 M. Hence high altitude weather conditions and topography always consequence in unavailability of fresh food and proper sunlight for the people. Porosity evident on limited areas of the bone especially vault and orbit or could have been a short term. Here it is noticeable that till today, Roopkund track covers approximately 35 km from the last bus stop and takes 3 to 4 days from the last village of the valley. This area covers the altitude from 1500 to 5000 M in the Himalaya. So, seeing today's environmental and geographical toughness of Roopkund track area, we can estimate the geography and weather hardness of thousands of years ago.

It could be possible that remains porosity is the result of short term anemia, caused by the long lack of fresh food, proper sunlight, which mainly occurs to these victims during their visit to Roopkund (other possibilities also can't ignore). But it's sure that this is not a cause of sudden death of the Roopkund victims.

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