Facial clefting in a XVII - XVI centuries BC from Lchashen site, Armenia

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Abstract

This paper identifies the presence of facial clefting in archaeological population from Middle Bronze Age and Late Bronze Age in Armenia. The remains of skeleton from Lchashen site (burial 221/2), comprise the skull and post-cranial skeleton of a female 30-39 years. Macroscopic physical examination revealed that individual suffered from inflammation. Considering the ethnographic aspects, the study reveals that inflammation possibly caused by because of sinusitis or inhaling polluted air for a long duration. In addition, we have seen skeletal evidence for pulmonary disease: tuberculosis. The severe dental wear is a direct result of the food processing techniques used by prehistoric Armenia. We have seen evidence of interpersonal violence. All of these factors suggest that the female from Lchashen led a physically strenuous lifestyle. Before us is the individual with signs of intensive exercise stresses.

Keywords: Armenia; facial clefting; sinusitis; periodontal disease

Introduction

Cleft defects of the primary and secondary palate are the most frequent birth malformation of the head and neck (1). There are two forms of cleft palate. The commonest, known as midline cleft palate, affects the back of the mouth, either unilaterally or bilaterally. Modem incidence of cleft palate is 1:400 (a world average, with variations between countries), with males affected twice as often as females (2). Barnes (3), however, states that females are affected more commonly than males. The second form may occur in association with cleft lip, in which case only the front of the mouth (the pre-maxilla) is affected.

A developmental delay in the formation of the roof of the mouth leads to the non-union of the palate. Clefts affecting the back of the mouth may be relatively insignificant, and covered in oral mucosa (a "sub-mucosal" defect), so that the individual may not have a serious problem with eating, drinking, or breathing. This type of defect is a "dorsal notch", affecting the posterior margin of the palate (3). Dorsal notches are the result of short delays in development, and clinically are often only discovered when individuals suffer from recurring middle ear infections, chest infections and hearing loss (3, 4, 5). Severe defects like this can also extend back along the maxilla into the mouth, leaving the mouth and the nose as one cavity instead of two. This can be surgically corrected today, but in the past it may have been incompatible with survival in some babies, as eating, drinking and breathing would be difficult for the infant (2, 4, 5, 6).

Acquired palatal perforations are produced and by other conditions. The unusual causes are exemplified by the gumma of tertiary syphilis. Tertiary syphilis is a non-infective multi-organ stage characterised by a painless localised granuloma (gumma) (7) which classically presents on the midline of the palate (8). Degradation of the mass leaves a deep pale ulcer with necrotic rolled margins (9). Chronic necrosis destroys the palatal bone to leave a clean perforation (10).

Oral tuberculosis is rare and accounts for less than 1% of all cases of tuberculosis (11). Oral tuberculosis may either be primary, or more often, secondary to pulmonary tuberculosis. In secondary oral tuberculosis, the bacilli reach the oral mucosa by hematogenous or lymphatic spread. In primary oral tuberculosis there is direct inoculation of the mycobacterium due to break or loss of the natural barrier resulting from trauma, inflammatory conditions, leukoplakia, tooth extraction, or poor oral hygiene (11). The palatal lesion of tuberculosis may be seen as granulomas, ulceration, or perforation and are usually more common in the hard palate than in the soft palate (12).

The incidence of defects caused by cocaine abuse is dependent upon its route of administration. Snorting most commonly results in an isolated septal perforation (13, 14) but can also lead to perforation of the hard palate (15).

Maxillary sinusitis is an infection of the sinus areas in the maxillae. Sinusitis is often associated with, or caused by, upper respiratory infections, allergic rhinitis, asthma, immunodeficiency disorders, and/or cystic fibrosis (16). Cleft lip and palate perturbs osseous and soft-tissue development of the nasolabial regions, often resulting in chronic maxillary sinusitis and mucosal thickening of the maxillary sinus (17).

Facial clefting not were seen in ancient skeletons from Armenia. Although it might be hypothesized that facial defects did not exist in the Armenia during earlier eras, from a biological standpoint, this supposition is unrealistic. The only instance of a palatal defect which was found is seen in Figure 1. The types of dental and maxillary anomalies found and their frequency in skeletons from Lchashen are discussed in detail by Khudaverdyan (18, 19). Very few article concerning defective plate crania are in the literature of paleopathology and mostly dated to later than the middle of the first millennium AD (20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30). Very few cleft skulls have been found in earlier archaeological specimens (31, 32, 33, 34, 35). Anderson (24) described the surgical repair of a cleft palate (although this must surely have been a cleft hp) during the English Anglo-Saxon period and a repair carried out in China c.390 BC has also been described (24, 32). The implications in the past for babies bom with an open cleft palate were potentially serious. Open clefts could prevent normal feeding, with the milk being expelled through the nose as the infant suckled (2, 4, 5, 6).

Materials and methods

Lake Sevan is the only large expanse of water in landlocked Armenia. When the level was reduced, a very extensive barrow cemetery was revealed at Lchashen. Mnacakanyan was

ehcavated from 1957-1967, but the excavations continues on archaeologist Petrosyan.

Figure 1. Perforation of the hard palate, with two small defects in the hard palate.

The Lchashen site is a mass (500) burial site, which includes at least 300 adult individuals of bone sexes and all ages (36), accompanied with many stone and bone tools, as well as ornamental objects. The burials were made in burial chambers, the walls of which were made of slabs weighing 2 to 5 tons. The ceilings were covered by logs supported by solid wooden columns, and the vaulted roof of huge slabs was placed thereon.

One of the burial 221 (excavated in 2004, Figure 2) of the Middle Bronze Age and Late Bronze Age (17rd to 16 centuries BC), was over 11.10 m in diameter and 1.20 metres high, and proved to cover a very rich chariot burial. There were in fact two burial chambers, one at the centre, and a second added on at the side like a sort of pimple. At the centre was the burial chamber with a two individuals, a 30-to-39-year-old female and a one-to-four-year-old child, presumably mother and child (the skull was absent).

The age-at-death and sex of individual were assessed through the use of multiple indicators: morphological features of the pelvis and cranium were used for the determination of sex (37, 38); a combination of pubic symphysis (39, 40, 41), auricular surface changes (42), degree of epiphyseal union (38), and cranial suture closure (41) were used for adult age estimation. For subadult, long bone length, and the appearance of ossification centres and epiphyseal fusion were used (38, 43). Measurements were taken as outlined in Alexseev (44, 45). The bone is measured on an osteometric board, and stature is then calculated using a regression formula developed upon individuals of known stature (46). Non-metric traits have been recorded for these skulls (47) and dentition (48, 49, 50) in order to allow future comparisons with findings from other sites of Armenia.

Gross observations of abnormal changes appearing in ancient skeletons principally provide the basic information for paleopathological diagnosis. In the present study, bearing in mind the various diseases, pathological changes were completely described and given tentative diagnosis.

Macroscopic analysis of the teeth relied on inspection and exploration of the teeth in their totality. The classification system that was used to rate tooth wear was Tooth Wear Index (TWI) as follows: Grade 0 - no apparent wear, Grade 1 - tooth wear is only apparent in enamel, Grade 2 - partial exposure of the dentin, including almost half of the occlusal surface, Grade 3 - the dentin is exposed in more than half of the occlusal surface, while there is still presence of enamel in some places, Grade 4 - total exposure of the dentin, without opening of the pulp cavity, and Grade 5 - high tooth wear leading to pulp cavity opening.

Antemortem tooth loss (AMTL) is characterised by remodelling of the alveolar bone that leads to the obliteration of the tooth sockets. AMTL was assessed based on evidence of resorption of alveolar bone around a tooth socket. If remodelling was evident, and the socket was partially (>2mm) or fully filled in, then a tooth was considered to have been lost antemortem (51).

Figure 2. Burial 221 from Lchashen.

Periodontal disease was assessed by measuring the amount of alveolar bone loss. Measurements were taken from the cemento-enamel junction to the surface of the alveolar bone. Only those measurements that exceeded 2mm were recorded as evidence of periodontal disease (51).
Calculus was recorded stating the location and severity of the formation. The location was recorded as supra- or sub-gingival based on the location of the deposit (on the crown or the root) and on the characteristics of the calculus (52). The severity was recorded as slight, medium or considerable deposition following Brothwell (23).

Results

The remains of a Middle Bronze Age and Late Bronze Age skeleton, burial 221/2, from Lchashen site, comprise the skull and post-cranial skeleton of a female 30-39 years. At 1.655m she was average height for an Lchashen female of the time. The following measurements (mm) were recorded from the skull: cranial breadth, 137.5; occipital breadth, 102; parietal chord, 98; occipital chord, 95; alveolar arch length, 59; alveolar arch breadth, 65; palatal length, 52; palatal breadth, 32; nasal breadth, 25. The following traits were presence: foramina infraorbitalia, os wormii suturae squamosum, os parietale bipartitum (incomplete) (Figure 3), os wormii suturae coronalis, foramina parietalia, os apicis lambda (Figure 3), os asterion, foramina mentalia, sulcus mylohyoideus (Figure 4), sutura mendoza. Teeth of the individual of the Lchashen are characterised by hypocone UM2 (Figure 1), four-cusped LM2. Two measurements, faciolingual (maxilla: M2 10мм, M3 10.5мм; mandible: M1 10.2 мм, M2 10мм, M3 9.5мм) diameter and mesiodistal (maxilla: M1 9мм, M2 9мм, M3 8.5мм; mandible: M1 9мм, M2 10мм, M3 10мм) diameter were taken for each M as described by Zubov (50).
The left parietal exhibits two separate depression fractures, on the right - one fracture. The fractures compressed outer tables, creating a disturbance of the endocranial surface. These injuries were most likely caused by multiple blows with a blunt instrument. These lesions is roughly circular and semi-circular in shape.
A severe case of chronic sinusitis was noted in the female. Maxillary sinusitis is an infection of the sinus areas in the maxillae. Bacteria, viruses, and fungi have all been noted as causing sinusitis, with bacteria the leading cause. In the clinical literature, sinusitis is often associated with, or caused by, upper respiratory infections, allergic rhinitis, asthma, immunodeficiency disorders, and/or cystic fibrosis (16), with upper respiratory infection being the most frequent cause. The inferior wall of the left maxillary sinus is completely resorbed.
The RM1 socket (Figure 1), the alveolus has been completely eroded by a massive lytic lesion. The internal sinus walls exhibit prominent reactive bone. Two holes (10×7.8 mm /left/ and 5×4 mm /right/) is present on the medial wall of the maxillary sinus, communicating through the inferior meatus into the nasal aperture. The anterior surface of the right maxilla displays reactive periosteal bone, indicating that the exterior portion of the bone was affected by periostitis, most likely a result of the sinusitis. The root apices of RM1 are

completely exposed by the eroded bone. The remaining of the molars from the maxillary left and right side were recovered; their presence indicates that the teeth and gums were still in place at the time of death. The severe infection led to dramatic bone and soft tissue damage. This individual was eventually unable to chew food. The infection of the maxilla was so extreme that hematogenous dissemination of the infectious agents could have occurred, possibly leading to the death of the individual (53).

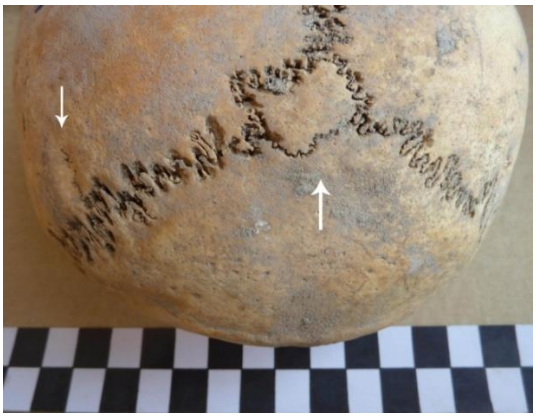

Figure 3. Non-metric trait/normal variation in the skeleton (os apicis lambda, os parietale bipartitum /incomplete/).

Figure 4. Non-metric trait/normal variation in the skeleton (sulcus mylohyoideus).

We found a correlation between the maxillary sinusitis with periodontal disease and tooth lost antemortem. Grade 3 of occlusal attrition in teeth is present (Figure 1). Tooth wear may have resulted from a variety of processes, including attrition, abrasion, and erosion. This woman it was have one tooth with calculus deposition (Figure 5). Calculus may harbour pathogenic bacteria which may lead to preriodontal disease. Some authors defend that calculus deposition may be mainly related to consumption of protein-rich food, as fish or meat (54, 55), whereas others have found that diets rich in carbohydrates may promote calculus deposition (56). Several experimental data (57) and clinical observations (58) support the view that both the presence of urea -a product of aminoacids metabolism- and alkaline pH contribute to plaque mineralisation.

In addition to a chronic sinusitis, had also possibly tuberculosis. It was on the internal (posterior) surface of the manubrium, which had a latticework appearance (Figure 6). Given that tuberculosis is characterized by lytic lesions and is known to affect the sternum to some degree, the presence of pronounced lattice-like porosity on the posterior surface of the manubrium could have potential associations with tuberculosis. Tuberculosis it is a chronic infectious disease caused by one of the microorganisms of the group Mycobacterium. The bacteria most often enter the human body through the respiratory tract, although intestinal infection can also occur. There is a direct human-human transmission caused by Mycobacterium tuberculosis, and there is transmission to humans from the consumption of bovine products caused by Mycobacterium bovis, and the latter transmission occurs relatively rarely (59, 60, 61).

Periostitis was located on the humerus, radius and tibia of female 221/2 and child 221/1 skeletons. A non-specific bacterial infection such as periostitis is probably caused by injury, and is observed by the formation of striated new bone on the cortical surface (62).

Musculoskeletal stress marker are ideal for the study of activity because they relate directly to muscle or joint use. It may be possible to determine not only which joints were heavily used, but the direction of loading on them. A deep radial fossa on the distal end of the humerus (Figure 7) could result from the habit of carrying loads in a bag slung over the shoulder and held in place with the hand. The arm is tightly flexed at the elbow so that the head of the radius impacts above the distal epiphysis of the humerus (63). The deltoid muscle (Figure 8) was used in flexing and adducting the arm (at the shoulder) and pulling it across the chest (medial rotation) (64). Both arms are affected. The constant pressure of the edge of the glenoid of the scapula on the

humerus shaft has led to a depression and loss of bone in the area below the humeral neck of both arms. The carrying of loads in a basket suspended from the back with the holding straps taken across the chest and over, rather than under, the arms was widespread in Europe, the Near East and North Africa (63).
The traits that characterize habitual horse-riders were observed in femora (Figure 9). These include hypertrophied ligament attachment areas around the fovea of the femur, as well as a pronounced linear aspera which supports attachment of the muscles that a rider uses to grip the back of the horse (65).

Figure 5. Periodontal disease, tooth lost antemortem and dental calculus.

Figure 6. Tuberculosis of sternum.

Figure 7. Radial fossa on the distal end of the humerus.

Figure 8. Deltoid muscle attachments on a humerus; robusticity score 3.

Figure 9. Left femur of skeleton, enthesopathies for gluteus maximus.

Discussion and conclusion

We have looked at a number of pathological conditions in a skeleton 221/2 from Lchashen. Our study of the paleopathology in this individual has shed some light on not only the health and disease aspects of this female. The transition from a hunting-gathering way of life to agriculture caused permanent settlements to arise, decreasing population mobility and increasing population density. This change resulted in exposure to many infections and diseases (19). Increased intake of carbohydrates in the diet has an adverse impact on overall health and in particular, dental health. Merrett and Pfeiffer (66) found a relationship between dental pathology and sinusitis in 28% of their cases. There is a strong possibility for oral bacteria to be transmitted from the mouth through the middle meatus to the maxillary sinus (67) suggesting a closer association between dental pathology and sinusitis than is directly observable. This is only one of the probable reasons. Further, the presence of chronic infections in combination with a compromised immune system leads to poor resistance and a disease-related stress may lead to overall poor health to individual. In combination with the health hazards mentioned, repetitive pregnancies further stressed both maternal and child health. Infections like maxillary sinusitis can be viewed as major indicators of the adverse effect of cultural practices on health of the individual.

Reddy (68) discusses etiologies for the occurrence of maxillary sinusitis in archaeological populations such as air pollution from different fuels, the aridity or humidity within environment, the diet of the people and dental pathology. Cooking and heating with solid fuels both lead to high levels of indoor air pollution, mainly a complex mix of health-damaging pollutants (e.g. particulate matter and carbon monoxide) (69). Many studies examine the effect of exposure to smoke by humans, with a particular focus on mothers and children. At the same time infants are exposed to pollutants as they are close to their mothers when they are engaged in domestic chores. Even after the cooking is finished, smoke lingers in the house for a long time as there are no windows. Not only is the environment inside the house polluted but also, the outside environment is contaminated with dust and other particles which create irritation in the upper respiratory tract. In the ancient societies, with the advancement in technology and agricultural production, many different occupational activities developed. It is evident that people were engaged in metal smelting, pottery making, brick making, leather making, quarrying etc. where there was a constant exposure to the polluted air and unwanted particles (70). Even different agricultural activities such as burning of weeds for preparing land for agriculture, cutting the dry crops and removing the husks from the grains creates a high potential for sinusitis.

In addition, we have seen skeletal evidence for pulmonary disease: tuberculosis. The oral pathologies that were discussed can be traced to cultural factors. The severe dental wear is a direct result of the food processing techniques used by prehistoric Armenia. We have seen

evidence of interpersonal violence. All of these factors suggest that the female from Lchashen led a physically strenuous lifestyle. Before us is the individual with signs of intensive exercise stresses. The signs of development of a relief is possible bound to regular riding are expressed. The potential information which can be obtained from this research is enormous, adding to our knowledge and understanding of past life ways and Armenia's rich and diverse prehistory.

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