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Multiple trauma in a horse rider from the Late Iron Age cemetery at Shirakavan, Armenia

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Abstract: *During recent excavations at a Late Iron Age cemetery in Shirakavan, Armenia, a fairly complete skeleton of a male individual buried together with a horse was found. Several bones exhibited signs of healed trauma, including a small blunt force lesion on the frontal bone, broken nose, fractured clavicle and two ribs as well as traumatic synostosis of tibia and fibula. There was also quite evident degenerative joint disease in the cervical and lumbar vertebrae as well as peculiar morphology of the proximal femora suggesting high load to this part of the body. This observed pattern of lesions suggests an active life and may be the consequence of habitual horse riding.*

Key words: trauma; degenerative joint disease; tibia-fibula exostosis; scoliosis; horse riding; Urartu kingdom

Introduction

In antiquity the Armenian Highland served as a crossroad linking east and west. Overland trade routes existed between the Near East through the Armenian Highland and the Caucasus to the Balkans and to the north Black Sea coast. Shirak is the northwestern province of the Armenian Highland (**Figure 1**), bordering Turkey and Georgia. The earliest known historical sources mention Shirak as Eriakhi, a province under the influence of Urartu (Haroutiounian 2001:505–508; Melikishvili 1960), an Iron Age kingdom in the Armenian Highland (Fuchs 2010). The campaigns of the Urartian kings throughout the 8th century BCE succeeded in subduing local polities and confederacies in the Ararat Plain and the Lake Sevan region but did not appear to have penetrated any farther north than the southern limits of the Shirak Plain, including the outpost on the north hill at Horom, nor to have incorporated territories east of the Ararat Plain in the mountainous areas of Nakhichevan (Azerbaijan) and

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Zangezur (Armenia) (Smith 2009). In much of the southern Caucasus the expansion of the Kingdom of Urartu may not have marked a major social or political transformation. The archeology of the region, in large measure, reflects the continuation of an earlier culture substrate, even within the Iron II period citadels of the Urartian kingdom.

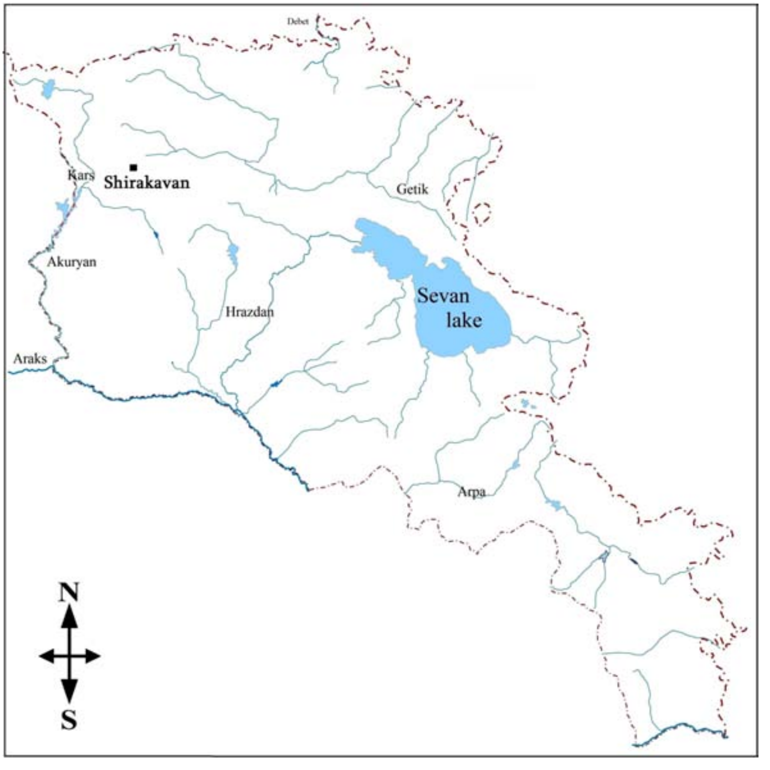

Figure 1. Map of Armenia showing the location of Shirakavan.

For the most part, Urartian archaeology has been the archaeology of fortresses (Karmir Blur, Armavir, Arinberd, Toprakkale, Bastam, Kefkalesi, Altmintepe, Aznavurtepe, etc.). These sites were royal residences and foci of military power (Kroll 1976:174). Thanks to the work of Piotrovski (1959) at Karmir Blur, Martirosyan's (1974) excavations at Argishtikhinili, Oganesyan's (1961, 1980) research at Erebuni, Avetisyan's (2001) work at the small fortress of Aragats, and investigations by Esaian and Kalantaryan (1988) and Kalantaryan et al. (2003) at Oshakan, the Ararat Plain has been the most thoroughly investigated region of the Urartian kingdom.

Urartu is so closely identified with the production of metal cauldrons, figurines, shields, helmets, horse trappings, belts, bowls, and plaques that "metalworking center" has been used by recent researchers (Merhav 1991; Torosyan et al. 2002; Gevorgyan & Bobokhyan 2014) as a common name for this kingdom.

Crop husbandry and stock-breeding were of primary importance in the Urartian economy (Zimansky 1998). In Urartu wheat, barley, sesame, millet and emmer were harvested, and gardens and vineyards were cultivated. Pastoralism, specifically husbandry of sheep and goats in seasonal transhumance, has been an important aspect of the economy (Piotrovski 1959; Zimansky 1985).

In the period of the Urartian kingdom, horses were occasionally buried in human graves (Devedjyan 1981; Torosyan et al. 2002). This tradition is attested among many Indo-European peoples (Kuzmina 2008) and indicates the high value of horses in the respective cultures (Kushnareva 1957).

In Armenia, horse burials (including chariots) have been identified from as early as the Middle Bronze Age (Devedjyan 2006; Simonyan 2006). According to Devedjyan (1981, 2006), numerous horse bones and skulls were deposited in graves at Lori Berd, usually in male burials. A similar case is known from the site of Azatan (unpublished material excavated in 2008 by Hamazasp Khachatryan and Larisa Eganyan) dating to the Late Bronze Age and Early Iron Age from Shirak plain.

Anthropological study of the skeleton provides an understanding of the individual as a functioning, living human being. The record of traumatic incidents imprinted upon a skeleton may contain a wealth of information about a lifetime of encounters with the environment and fellow humans. Here we report the pattern or injuries in a skeleton from Shirakavan, a cemetery dated to the Late Iron Age (i.e. the period when the Urartian kingdom flourished), buried together with a horse.

Material

Altogether, remains of 21 individuals were found in the cemetery at Shirakavan during four years of excavations (2008-2011) by Hamazasp Khachatryan and Larisa Eganyan (Shirak Regional Museum, Gyumri). All of the burials appear to have been typical Iron Age interments (c. 9^{th}–6^{th} c. BCE), oriented on an east-west axis (**Figure 2**).

There is as yet no definitive report of the excavation of Shirakavan as the field work at this site was only completed in the autumn of 2015. Therefore, all information here is from preliminary reports. The individual in question was buried in a stone box (size 2.5×1.4m), oriented on an east-west axis. According to the grave drawing, a horse skeleton and artifacts were all found near the human skeleton, at a depth of 2m (**Figure 3**). Apart from human and animal bones, the grave also contained a black polished pitcher, a small kitchen bowl, bronze buds chainmail, arrowheads and fragments of two iron knives.

Figure 2. The cemetery at Shirakavan; the male burial discussed here was found in the western part of the graveyard marked with an arrow.

Methods

The skeleton was analysed in detail, assessing for preservation and completeness, as well as determining age-at-death and sex of the individual. Morphological features of the pelvis and cranium were used for the sex assessment (Phenice 1969; Buikstra & Ubelaker 1994:16). A combination of pubic symphysis (Gilbert & McKern 1973; Katz & Suchey 1986; Meindl et al. 1985), auricular surface changes (Lovejoy et al. 1985), degree of epiphyseal union (Buikstra & Ubelaker 1994:16), and cranial suture closure (Meindl et al. 1985) were used for adult age-at-death estimation.

All bones were examined macroscopically for evidence of traumatic lesions. The location of fractures in areas of the skeleton was recorded using description combined with measurements from anatomical landmarks. The scoring protocol followed the descriptive terms outlined in Lovell (1997:141–144).

Antemortem trauma was distinguished from perimortem trauma by the appearance of new bone deposits, resulting in callus formation or beveled edges (Aufderheide & Rodriguez-Martin 1998). Careful observation of the lesions (with 4× or 10× magnification) was applied for assessing the degree of healing.

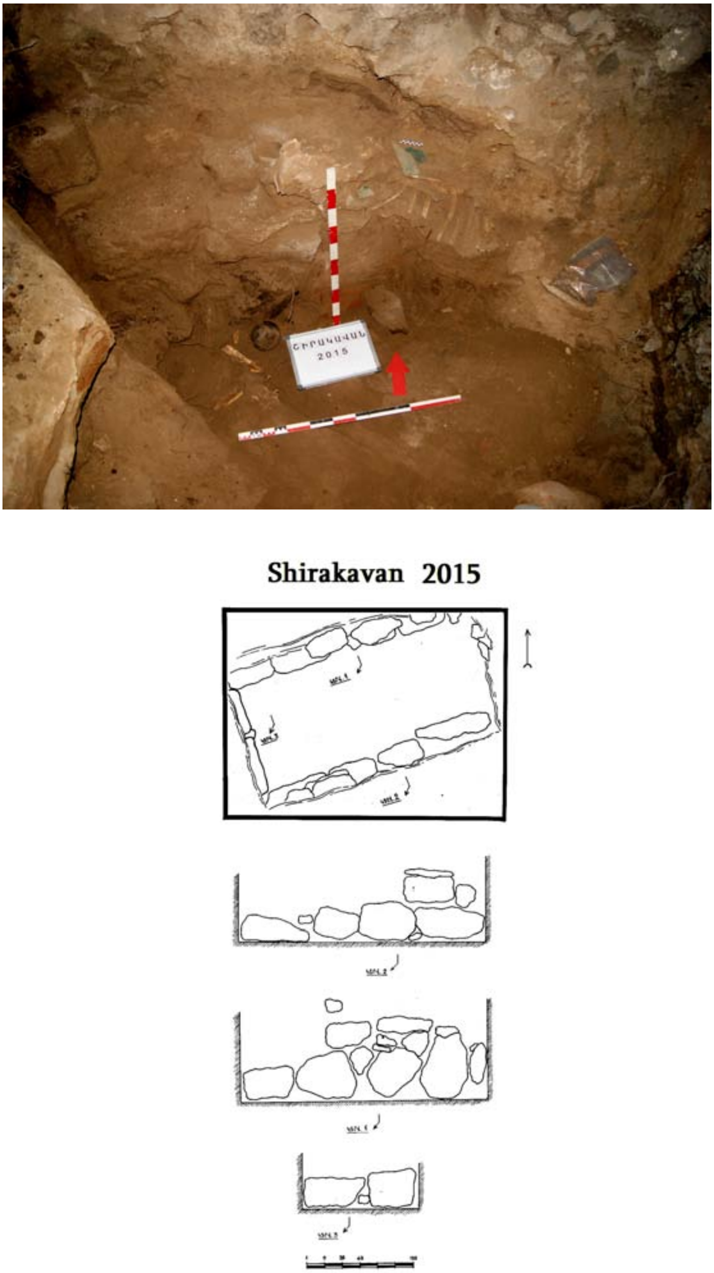

Figure 3. Picture and plan of the burial discussed in the text.

The diagnostic criteria used for assessing characteristics of degenerative joint disease include marginal and surface osteophytes, porosity, and eburnation (Rogers & Waldron 1995; Waldron 2009).

Results

The skeleton was fairly complete and well preserved (**Figure 4**). Morphological features of the pelvis and cranium indicate that it belonged to a mature adult male (40-49 years).

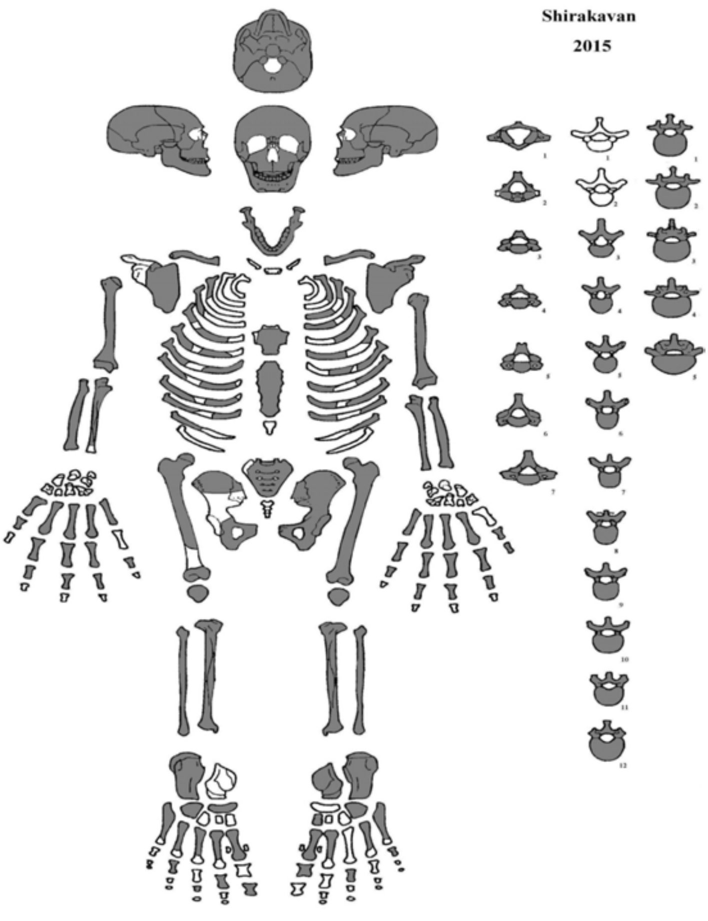

Figure 4. Completeness of the human skeleton from Shirakavan.

This individual has healed blunt force trauma to the frontal bone above the nasal bones (**Figure 5**). The maximum width of this injury is 2mm and it is 3mm in length.

The lesion had puckered beveled edges indicating that some healing had occurred. This individual also exhibits a well healed traumatic injury of the left nasal bone (**Figure** 5).

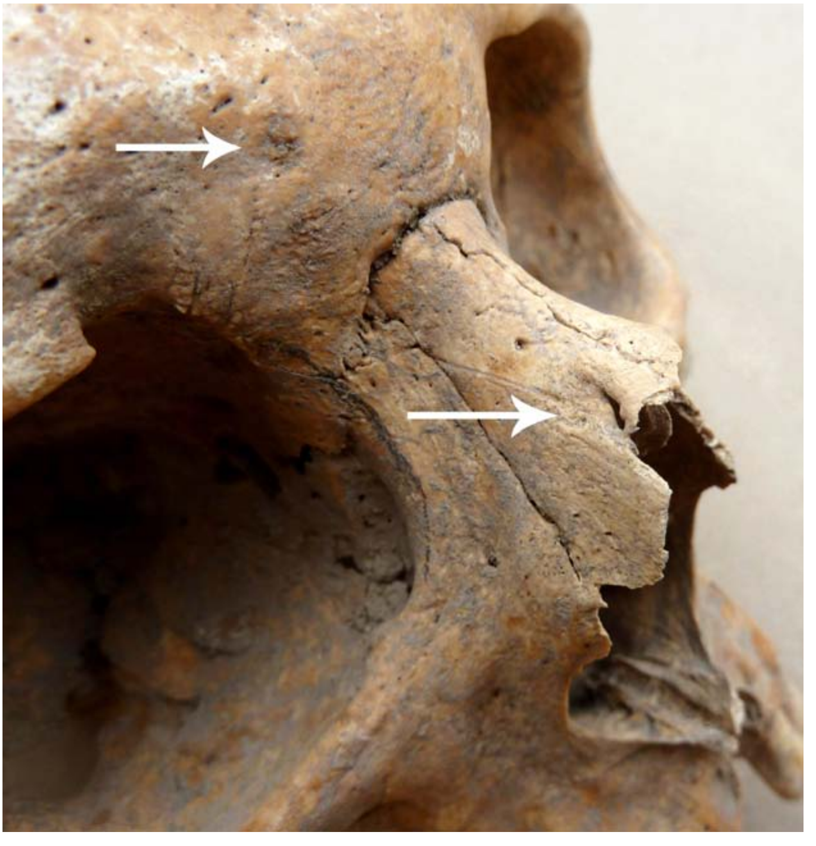

Figure 5. Healed nose fracture and trauma to the frontal bone.

Two well-healed rib fractures were observed. On the left side, the fracture involved the 8^{th} and 9^{th} ribs near the angle (**Figure 6**). An oblique fracture is present on the right clavicle (**Figure** 7). The affected clavicle was shorter than the contralateral (left=149mm, right=146mm) and the bone exhibited angular deformity in alignment. We also found an opening in the posterior part of the clavicle, possibly representing a cloaca penetrating into the marrow space accompanied by a bony fragment healed in a malaligned position. All of these traumatic injuries suggest that this individual may have had osteomyelitis as a complication after clavicle fracture.

The proximal tibiofibular synostosis was present on the right side (**Figure 8**). The original joint surface is not recognizable as a result of the newly formed bony bridge

Figure 6. A possible transverse fracture of the 8th rib.

Figure 7. Fracture of the right clavicle.

between the two articular surfaces. Following the fracture it is evident that infection occurred. Fracture of the tibia and fibula exposed the marrow cavity resulting in the onset of osteomyelitis, as suggested by three cloacae on the bone surface. Nevertheless, the X-ray (**Figure 9**) revealed perfect healing of the medullary cavity without remnants of fracture lines or abscess cavities.

Figure 8. Proximal tibiofibular synostosis.

Both tibial tuberosities of this individual are rugged and irregular at their distal extent deviating laterally (**Figure 8**). These changes are consistent with symptoms of Osgood-Schlatter's disease (Digangi et al. 2010), which affects the attachment of the patellar tendon at the tibial tuberosity. Such skeletal alteration is considered to be traumatic in origin and resulting from excessive strain on the tendon pulling on the developing area of bone. Some cone-shaped osseous exostoses were also present on the calcaneal tuberosity (**Figure 10**).

Figure 9. X-ray of the tibiofibular synostosis.

Figure 10. Exostosis on the calcaneal tuberosity.

In the proximal femora, bony spicules or exostosis were observed in the trochanteric fossa, which also exhibits a Poirier facet (i.e. bulging of the articular surface of the femoral head toward the anterior portion of the femoral neck) (**Figure 11**) (Capasso et al. 1999). This individual also suffered from degenerative joint disease, especially in the vertebral column (**Figures 12, 13**). There is some pitting on the bodies of the cervical vertebrae indicating disc damage in this part of the spine.

Several vertebrae were asymmetrical (scoliosis), with the vertebral body not being kidneyshaped, but more tear drop shaped. Such alteration is present in cervical vertebrae 2 to 9 (**Figure 12**) and lumbar vertebrae 3 to 5 (**Figure 13**). None of the other vertebrae show any marked asymmetry of the vertebral body. However, the pedicles of several vertebrae were larger on one side than the other.

Discussion and conclusion

The presence of a horse skeleton in the discussed grave suggests that the human skeleton may have belonged to a horse rider and therefore it allows discussion regarding whether the observed pattern of trauma and degenerative joint disease may be consistent with skeletal alterations resulting from habitual activity, namely horse ridding. Horse riders sit on a saddle with the lower back slightly extended, the hips flexed and abducted, the knees flexed, and the ankles dorsiflexed. To achieve and maintain

Figure 11. Morphology of proximal femur. Note the Poirier's facet and porosity.

Figure 12. Asymmetry and degenerative joint disease in the 5th and 7th cervical vertebrae.

Figure 13. Asymmetry and degenerative joint disease in the 3rd and 5th lumbar vertebrae.

such posture in horse riding, the leg, abdominal, and back muscles are heavily loaded. In addition to maintaining balance and posture on the horse (Alfredson et al. 1998; Pugh & Bolin 2004; Meyers 2006), riders use their legs to drive, turn, and move the horse laterally (Pugh & Bolin 2004). Horse riders squeeze their legs on the side of the horse to provide cues, therefore, rider's legs are constantly working during the ride. Squeezing of their legs into the horse places the legs in a *genu varum* position (Pugh & Bolin 2004). With such a rigorous leg position in horse riding, it is expected that flexibility and strength adaptations occur in response to the physical demands from the activity. Repetitive tensile force applied to the muscles during horse riding causes tightness of the muscles, leading to limited range of motion of the muscle (Kibler et al. 1992).

At the proximal end of the femur belonging to the individual from Shirakavan, there are some enthesopathies previously noted as common in horse riders (Molleson & Blondiaux 1994; Molleson 2007). In intensive horseback riding for instance, the *linea aspera* on the femur can become very pronounced due to strain of the adductor and some other muscles (Capasso et al. 1999:104). The femora of the Shirakavan skeleton has a strongly developed *linea aspera* in conjunction with pronounced areas of insertion of all three gluteal muscles, but especially of the *gluteus minimus* and *gluteus medius* on the greater trochanter. There is also a distinct spicule in the trochanteric fossa. The orientation of the lesser trochanter or Poirier's facet together with the unilateral expression of enthesopathies in the calcaneus, would be consistent with the pattern expected in habitual horse riding. Exostosis of the trochanteric fossa has been linked to prolonged sitting posture with the lower limbs extended (Capasso et al. 1999).

Various researchers have shown that behavioral models and general lifestyle may be reflected by the specific patterns of degenerative joint pathology (Ortner 1981; Angel 1966). A generally accepted principle about osteoarthritis is that changes observed in and/or around the joints may be representative of modifications due to biomechanical factors such as trauma or activity, and those patterns have certain implications in the interpretation of lifestyle of individuals (Angel 1966; Bridges 1991). In horse riders, for example, higher incidence of cervical and lumbar degenerative spondyloarthropathy has been suggested (Tsirikos et al. 2001). The rider's posture causes the muscles in the back to contract to balance the spine and to prevent injury, which leads to large compressive forces being produced resulting in greater pressure placed on the intravertebral discs and facet joints (Nicol et al. 2014).

Paleopathological research on the hip joint area considers the relationship between osteoarthritis and activity, and how an individual would sustain variable amounts of wear on this joint depending on lifestyle hardships (Jurmain 1999; Rogers & Waldron 1995; Weiss & Jurmain 2007). Patterns of hip osteoarthritis have been found in association with horseback riders from the American Great Plains (Bradtmiller 1983). These patterns have been explained as the result of specific loading which occurs during horse-back riding (Reinhard et al. 1994).

Several features of the traumatic lesions observed in the individual from Shirakavan have the potential to provide information regarding the experience of accidents and/or violent activities. Falling from a horse was the most common mechanism of injury in horse riders (Hobbs et al. 1994; Norwood et al. 2000; Sorli 2000; Ball et al. 2007, 2009; Loder 2008; Eckert et al. 2011). The head and extremities are the most commonly involved body areas in horse riding related injuries. The most common cranial vault injury is concussions without concomitant skull fractures or intracranial hemorrhage (Srinivasan et al. 2014). The male from Shirakavan suffered two cranial fractures, in nasal bones and frontal bone. Both healed well, without complications. Although such cranial and facial lesions are often used as indicators of interpersonal violence (Brasili et al. 2004; Djuric et al. 2006; Galloway 1999; Judd 2004, 2006; Smith 2003; Walker 1989), they may also be the result of direct blows to the face resulting from falling off of a horse (Lovell 1997).

Fractures of the ribs can have varied causes, ranging from direct injury to falls against hard objects (Lovell 1997). Ribs (especially the 8^{th} and 9^{th}) are usually fractured near the angle if the force is applied from the front (Sheridan 2004:301). Single fractures are usually caused by direct blows, whereas multiple fractures often appear because of violent trauma produced by a large object or by compression on the rib cage (Aufderheide & Rodriguez-Martin 1998). Fractures in the individual from Shirakavan may be the result of direct blows to the chest from falling off of a horse.

The clavicle injury observed in the individual discussed here can also be caused by a fall. The severity of the injury in the present case is consistent with a fall from a standing height (Galloway 1999:251-252). In a study of 122 modern patients, 87% of clavicle injuries resulted from a fall onto the shoulder, 7% resulted from a direct blow, and 6% resulted from a fall onto an outstretched hand (Stanley & Norris 1988). The individual from Shirakavan exhibits a type I fracture, i.e. a fracture occurring at the midshaft of the clavicle (Allman 1967), and he probably fell directly onto his right shoulder. Clavicular shortening has been associated with some shoulder discomfort and disfunction and can alter the dynamics upper limb mechanics (Hill et al. 1997; McKee et al. 2004).

Lower extremity injury may occur from impact with the ground. Trauma can cause synostosis between the tibia and fibula, either with (Flandry & Sanders 1987) or without (Harborne & Lennox 1989; Frick et al. 2001; Khudaverdyan 2014) a fracture of the tibia. Reports of synostosis of the proximal tibiofibular joint are exceedingly rare and the case observed in Shirakavan is consistent with a type II injury (Gamble 1984) where a fibula of normal length shows mild bowing and widening of the interosseous distance in the proximal half only. The injuries on the clavicle, tibia and fibula were accompanied by infection and were followed by severe degenerative alterations. These injuries could have caused long-term disabilities (Dekker et al. 2004).

This study of the individual from Shirakavan reveals a complex picture of lifestyle through the pattern of extensive pathology observed. Having been interred with a horse it is possible that the suite of pathological alterations identified on the skeleton of this individual, including trauma, degenerative joint disease and alteration of the morphology of the hip area, may be the result of habitual horse riding over a lifetime.

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References

Alfredson H., Hedberg G., Bergstrom E., Nordstrom P., Lorentzon R. (1998), *High thigh muscle strength but not bone mass in young horseback-riding females*, Calcified Tissue International 62:497-501.

Allman F.L. jr. (1967), *Fractures and ligamentous injuries of the clavicle and its articulation*, Journal of Bone & Joint Surgery 49(4):774–784.

Angel J.L. (1966), *Early skeletons from Tranquility, California*, Smithsonian Contributions to Anthropology 2:1-19.

Aufderheide A.C., Rodriguez-Martin C. (1998), *The Cambridge encyclopedia of human paleopathology*, Cambridge: University Press.

Avetisyan P.S. (2001), *Aragats*, Yerevani: Hamalsarani Hratarakchutyun.

Ball C.G., Ball J.E., Kirkpatrick A.W., Mulloy R.H. (2007), *Equestrian injuries: incidence, injury patterns, and risk factors for 10 years of major traumatic injuries*, American Journal of Surgery 193:636–640.

Ball J.E., Ball C.G., Mulloy R.H., Datta I., Kirkpatrick A.W. (2009), *Ten years of major equestrian injury: are we addressing functional outcomes?*, Journal of Trauma Management & Outcomes 3:2.

Bradtmiller B. (1983), *The effect of horseback riding on Arikara arthritis patterns*, paper presented at the 82nd Annual Meeting of the American Anthropological Association, Chicago.

Brasili P., Bianchi E., Ventrella A. (2004), *Traumatic events and life-style in ancient Italian populations*, Collective Anthropology 28(1):179-191.

Bridges P.S. (1991), *Degenerative joint disease in hunter-gatherers and agriculturists from the Southeastern United States*, American Journal of Physical Anthropology 85:379-392.

Buikstra J.E., Ubelaker D.H. (eds.) (1994), *Standards of data collection from human skeletal remains*, "Arkansas Archaeological Survey Research Series" 44, Fayetteville.

Capasso L., Kennedy K., Wilczak C. (1999), *Atlas of occupational markers on human remains*, Teramo: Edigrafital S.P.A.

Dekker R., Van Der Sluis C.K., Kootstra J., Groothoff J.W., Eisma W.H., Duis H.J. (2004), *Longterm outcome of equestrian injuries in children*, Disability & Rehabilitation 26:91-96.

Devedjyan S.H. (1981), *Lori-Berd*, vol. I, Erevan: National Academy of Science of Armenia.

Devedjyan S.H. (2006), *Lori-Berd*, vol. II, Erevan: National Academy of Science of Armenia.

Digangi E., Bethard J., Sullivan L. (2010), *Differential diagnosis of cartilagenous dysplasia and probable Osgood-Schlatter's disease in a Mississippian individual from Tennessee*, International Journal of Osteoarchaeology 20:424-442.

Djuric M., Roberts C., Rakocevic Z., Djonic D., Lesic A. (2006), *Fractures in Late Medieval skeletal populations from Serbia*, American Journal of Physical Anthropology 130:167-178.

Eckert V., Lockemann U., Püschel K., Meenen N.M., Hessler C. (2011), *Equestrian injuries caused by horse kicks: first results of a prospective multicenter study*, Clinical Journal of Sport Medicine 21:353–355.

Esaian S.A., Kalantaryan A.A. (1988), *Ochakan 1: Osnovnie resultati raskopok 1971-1983gg* [Oshakan I: main results of the 1971-1983 excavation seasons], Arkheologicheskie pamiatniki Armenii 18 [Archaeological Monuments of Armenia 18], Yerevan: Izdatelstvo Armyaskoi SSR.

Flandry F., Sanders R.A. (1987), *Tibiofibular synostosis: an unusual case of shin-splint-like pain*, American Journal of Sports Medicine 15:280-284.

Frick S.L., Shoemaker S., Mubarak S.J. (2001), *Altered fibula growth patterns after tibiofibular synostosis in children*, Journal of Bone and Joint Surgery, American Volume 83A:247–254.

Fuchs A. (2010), *Urartu in der Zeit*, Acta Iranica 51:135-161.

Galloway A. (1999), *Broken bones: Anthropological analysis of blunt force trauma*, Springfield, IL: Charles C. Thomas.

Gamble J.G. (1984), *Proximal tibiofibular synostosis*, Journal of Pediatric Orthopedics 4:243-245.

Gevorgyan A., Bobokhyan A. (2014), *Metallurgy of ancient Armenia in cultural and historical context*, Journal of Armenian Studies 1:47-98.

Gilbert B.M, McKern T.W. (1973), *A method for aging the female* os pubis, American Journal of Physical Anthropology 38:31-38.

Harborne D.J., Lennox W.M. (1989), *Distal tibiofibular synostosis due to direct trauma*, Injury 20:377-378.

Haroutiounian N.V. (2001), *Korpus urartskikh klinoobraznykh nadpisei* [Corpus of Urartian cuneiform inscriptions], Yerevan: Gitutyun.

Hill J.M., McGuire M.H., Crosby L.A. (1997), *Closed treatment of displaced middle-third fractures of the clavicle gives poor results*, Bone & Joint Journal 79(4):537–539.

Hobbs G.D., Yealy D.M., Rivas J. (1994), *Equestrian injuries: a five-year review*, Journal of Emergency Medicine 12:143–145.

Judd M. (2004), *Trauma in the city of Kerma: Ancient versus modern injury patterns*, International Journal of Osteoarchaeology 14:34-51.

Judd M. (2006), *Continuity of interpersonal violence between Nubian communities*, American Journal of Physical Anthropology 131:324-333.

Jurmain R.D. (1999), *Stories from the skeleton: Behavioural reconstruction in human osteology*, The Netherlands: Gordon and Breach Publishers.

Kalantaryan A.A., Melkonyan U.A, Zhamkochyan A.S., Babayan F.S., Piliposyan A.S., Kanetyan A.G. (2003), *Rezul'tati raskopok 2002g. v Oshakane* [The results of the excavations in 2002 in the Oshakan] [in:] L.A. Abramyan, R.S. Badalyan, L. Vardanyan, A.A. Kalantaryan, G. Kharatyan, "Arkheologia, etnologia i fol'kloristika Kavkaza" [Archaeology, ethnology and folklore of the Caucasus], Yerevan: Pervoprestol'nyj Svyatoi Echmiadzin, pp. 112-121.

Katz D., Suchey J.M. (1986), *Age determination of the male* os pubis, American Journal of Physical Anthropology 69:427-435.

Khudaverdyan A. (2014), *Trauma in human remains from Bronze Age and Iron Age archaeological sites in Armenia*, Bioarchaeology of the Near East 8:29–52.

Kibler W.B., Chandler T.J., Stracener E.S. (1992), *Musculoskeletal adaptations and injuries due to overtraining*, Exercise & Sport Sciences Reviews 20:99-126.

Kroll S. (1976), *Keramik urartdischer Festungen in Iran*, Archäologische Mitteilungen aus Iran, Erginzungsband 2, Berlin: Reimer.

Kushnareva K.Kh. (1957), *Nekotorie pamyatniki epokhi pozdnei bronzi v Nagornom Karabakhe* [Some monuments of Late Bronze Age in the Nagorno-Karabakh], Soviet Archeology 27:135-177.

Kuzmina E.E. (2008), *Arii – put' na yug* [Aria – way south], Moscow: Summer Garden.

Loder R.T. (2008), *The demographics of esquestrian-related injuries in the United States: injury patterns, orthopedic specific injuries and avenues for injury prevention*, Journal of Trauma & Acute Care Surgery 65:447-460.

Lovejoy C.O., Meindl R.S., Pryzbeck T.R., Mensforth R.P. (1985), *Chronological metamorphosis of the auricular surface of the ilium: A new method for the determination of adult skeletal age at death*, American Journal of Physical Anthropology

68:15-28.

Lovell N.C. (1997), *Trauma analysis in paleopathology*, Yearbook of Physical Anthropology 40:139-170.

Martirosyan A. (1974), *Argishtikhinili. Arkheologicheskie pamiatniki Armenii 8* [Argishtikhinili. Archaeological sites in Armenia 8], Urartskie Pamiatniki 1 [Urartu Monuments 1], Yerevan: Izdatelstvo Armyaskoi SSR.

McKee M.D., Wild L.M., Schemitsch E.H. (2004), *Midshaft malunions of the clavicle. Surgical technique*, Journal of Bone & Joint Surgery, 86A(Suppl 1):37–43.

Meindl R.S., Lovejoy C.O., Mensforth R.P., Carlos L.D. (1985), *Accuracy and direction of error in the sexing of the skeleton: Implications for paleodemography*, American Journal of Physical Anthropology 68:79-85.

Melikishvili, G.A. (1960), *Urartskie klinoobraznye nadpisi* [Urartian cuneiform inscriptions], Moscow: Izdatel'stvo Akademii Nauk SSSR.

Merhav R. (1991), *Urartu: A metalworking center in the first millennium B.C.*, Jerusalem: The Israel Museum.

Meyers M.C. (2006), *Effect of equitation training on health and physical fitness of college females*, European Journal of Applied Physiology 98:177-184.

Molleson T. (2007), *A method for the study of activity related skeletal morphologies*, Bioarchaeology of the Near East 1:5-33.

Molleson T., Blondiaux J. (1994), *Riders' bones from Kish*, Cambridge Archaeological Journal 4:312-316.

Nicol G., Arnold G.P. Wang W., Abboud R.J. (2014), *Dynamic pressure effect on horse and horse rider during riding*, Sports Engineering 17(3):143-150.

Norwood S., McAuley C., Vallina V.L., Fernandez L.G., McLarty J.W., Goodfried G. (2000), *Mechanisms and patterns of injuries related to large animals*, Journal of Trauma & Acute Care Surgery 48:740–744.

Ortner D.J. (1981), *Identification of pathological conditions in human skeletal remains*, Washington: Smithsonian Institution Press.

Oganesyan K. (1961), *Arin-Berd 1: Architektura Erebuni po materialam raskopok 1950-1959gg* [Arin-Berd 1: Architecture of Erebuni, excavation materials 1950-1959], Arkheologicheskie raskopki v Armenii 9 [Archaeological sites in Armenia 9], Yerevan: Akademia Nauk Armianskoi SSR.

Oganesyan K. (1980), *Krepost' Erebuni, 782g. do n.e.* [Erebuni fortress, 782 BC], Yerevan: Akademia Nauk Armianskoi SSR.

Phenice T.W. (1969), *A newly developed visual method of sexing the* os pubis, American Journal of Physical Anthropology 30:297-302.

Piotrovski B.B. (1959), *Vanskoe carstvo (Urartu)* [Kingdom of Van (Urartu)], Moscow: East Literature.

Pugh T.J., Bolin D. (2004), *Overuse injuries in equestrian athletes*, Current Sports Medicine Reports 3:297-303.

Reinhard K., Reinhard L.T., Sandness K.L., Beiningen L.M., Miller E., Ghazi A.M., Miewald C.E., Barnum S. V. (1994), Trade, contact, and female health in northeast Nebraska [in:] "The wake of contact: Biological responses to conquest", C.S. Larsen, G.R. Milner (eds.), Wiley-Liss: New York, pp. 63-74.

Rogers J., Waldron T. (1995), *A field guide to joint disease in archaeology*, New York: John Wiley.

Sheridan R.L. (2004), *The trauma handbook of the Massachusetts General Hospital*, Philadelphia: Lippincott Williams & Wilkins.

Simonyan A. (2006), *Verin Naver. Rezultati raskopok 1976-1990gg* [Verin Naver, The results of the excavations 1976-1990], vol. 1, Yerevan: Yerevan University.

Smith A.T. (2009), *Historical and anthropological problems in the archaeology of Southern Caucasia* [in:] "The archaeology and geography of ancient Transcaucasian societies, vol. 1: The foundations of research and regional survey in the Tsaghkahovit plain, Armenia", A.T. Smith, R.S. Badalyan, P.S. Avetisyan (eds.), Chicago: The University of Chicago, pp. 21-32.

Sorli J.M. (2000), *Equestrian injuries: a five year review of hospital admissions in British Columbia, Canada*, Injury Prevention 6:59–61.

Smith M.O. (2003), *Beyond palisades: The nature and frequency of late prehistoric deliberate violent trauma in the Chickamauga Reservoir of East Tennessee*, American Journal of Physical Anthropology 121:303-318.

Srinivasan V., Pierre C., Plog B., Srinivasan K., Petraglia A.L., Huang J.H. (2014), *Straight from the horse's mouth: neurological injury in equestrian sports*, Neurological Research 36(10):873-877.

Stanley D., Norris S.H. (1988), *Recovery following fractures of the clavicle treated conservatively*, Injury 19(3):162–164.

Torosyan R.M., Hnkikyan O.S., Petrosyan L.A. (2002), *Hin Shirakavanje (1977-1981 pehumneri ardyunqnerje)* [Ancient Shirakavan, the results of 1977-1981 excavations], Hasuatani hnagitakan arshavahmberje [Archaeological Excavations in Armenia], Yerevan & Gitutyun: Science.

Tsirikos A., Papagelopoulos P.J., Giannakopoulos P.N., Boscainos P.J., Zoubos A.B., Kasseta M., Nikiforidis P.A., Korres D.S. (2001), *Degenerative spondyloarthropathy of the cervical and lumbar spine in jockeys*, Orthopedics 24(6):24561–24564.

Waldron T. (2009), *Paleopathology*, Cambridge: University Press.

Walker P.L. (1989), *Cranial injuries as evidence of violence in prehistoric Southern California*, American Journal of Physical Anthropology 80:313-323.

Weiss E., Jurmain R. (2007), *Osteoarthritis revisited: a contemporary review of aetiology*, International Journal of Osteoarchaeology 17:437–450.

Zimansky P.E. (1985), *Ecology and empire: The structure of the Urartian state*, Chicago: The University of Chicago.

Zimansky P.E. (1998), *Ancient Ararat. A handbook of Urartian studies*, New York: Caravan Books.