



Horse-riding accidents and injuries in historical records of Joseon Dynasty, Korea



Ho Chul Ki^{a,1}, Eun-Kyoung Shin^{b,1}, Eun Jin Woo^c, Eunju Lee^d, Jong Ha Hong^e, Dong Hoon Shin^{e,*}

^a Ancient Institute of Heritage, Jukhyun-ro 514, Hwasun-gun, Jollanam-do, Republic of Korea

^b Department of Social Welfare, Dankook University, Cheonan-si, Republic of Korea

^c Department of Oral Biology, Division in Anatomy & Developmental Biology, BK21 PLUS Project, Yonsei University College of Dentistry, Seoul, Republic of Korea

^d Department of Internal Medicine, Asan Medical Center, University of Ulsan, Seoul, Republic of Korea

^e Lab of Bioanthropology, Paleopathology and History of Diseases, Seoul National University, Seoul, Republic of Korea

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ABSTRACT

Only a few osteological reports describe bone injuries thought to have been caused by falls from horses. Nevertheless, anthropological study alone is insufficient for establishing the correlates of such equestrian accidents. We therefore reviewed the records in *Seungjeongwon ilgi* (Diaries of the Royal Secretariat) and *Joseon wangjo silrok* (Annals of the Joseon Dynasty) of the Korea's Joseon period (1392–1910 CE). Although the mechanisms of trauma were diverse, the Joseon documents recorded many injuries caused by horse-riding accidents. During 1625–1872 CE, equestrian-related accidents occurred almost every year, overwhelming other causes of trauma. In all horse-riding accidents (n = 142), 37.77% of the records offer detailed data about the traumatic mechanism. Injuries occurred most frequently to the extremities (79.58%), which were followed by the trunk (34.5%) and head (4.92%). Although we do not think that this attempt can explain every paleopathological case, our historical review shows that equestrian-related injuries could be considered as one of the major causes for the bone trauma observed among ancient equestrian people.

1. Introduction

Bone trauma is one of the paleopathological processes frequently identified in ancient bones. While osteological examination is a fundamental part of studies of ancient peoples, questions still remain about the details. Explanations for a specific injury in paleopathology, are markedly enhanced by relevant historical evidence, such as the accounts describing the injury and death, as seen in the case of King Henry II of France (Faria, 1992).

Researchers have reported fractures or other blunt-force injuries thought to have been the results of falls from horses. As Bixby-Hammett and Brooks (1990) pointed out, “no horse is a safe horse; some are safer than others but the horse is a potentially lethal animal.” In considering the dangers of horseback riding, we can posit that the seriousness of such accidents and their consequences might have been similar in many past societies even if the horse types and the specific situation of the accidents differed.

For instance, Angel (1982) reported high frequencies of calcaneal fractures that he associated with frequent dismounting from horseback.

Holck (2007) argued that whiplash injury is not a new trauma due to car accidents, it could also be achieved by falling from a horse or being knocked out in a battle. By an anthropological examination of a male skeleton of the Middle Ages in Oslo, he showed that the individual's neck injury was possibly the consequence of a fall from a running horse or even rough treatment. Wentz and de Grummond (2009) also found that a Scythian individual's long bone injuries were consistent with a fall from a moderate height, perhaps from a horse. The skeleton underscored Scythians' rigorous life on horseback. Boccone et al. (2011) reported on the pathology of a male skeleton with multiple fractures found in Florence, Italy. By reconstructing the dynamics of the accident, they speculated that the severe trauma might have been due to a fall from a significant height, possibly from an animal-drawn vehicle or from a horse. Recent excavation at a Late Iron Age cemetery in Shirakavan, Armenia also reported a male skeleton buried together with a horse (Khudaverdyan et al., 2016). They found several bones with signs of healed trauma on the frontal bone, clavicle, rib, tibia, fibula, that might have been the consequences of horse riding.

Such studies alone are insufficient, however, for establishing the

* Corresponding author at: Lab of Bioanthropology, Paleopathology and History of Diseases, Institute of Forensic Science, Seoul National University College of Medicine, Daehak-ro 103, Jongno-gu, Seoul 03080, Republic of Korea.

E-mail address: cuteminjae@gmail.com (D.H. Shin).

¹ These authors equally contributed to this study.

behavioral correlates of such extensive bone trauma with falls from horses. In this regard, we note that information from ancient historical texts can enhance our understanding of disease in the past (Patterson, 1998; Metcalfe, 2007; Mitchell, 2016), including equestrian accidents.

In this study, we examine the details of injuries described in the written records of the Joseon Dynasty in comparison to injury patterns observed in selected clinical reports of equestrian injuries. In fact, a compilation of historical studies would be useful for paleopathologists because different peoples in vastly different geographic regions and cultures have the shared experience of horse-riding injuries. We anticipate that this broad perspective, informed by both historical and archaeological examples, will render our paleopathological investigations and interpretations more robust than when any one line of evidence is considered alone.

2. Materials and methods

2.1. Historical documents

One of the historical records of the Joseon Dynasty examined in this study is the *Seungjeongwon ilgi* (listed in UNESCO's Memory of the World registry). During the Joseon period, the royal secretaries recorded everyday affairs of the kingdom in great detail, combining them to make a huge volume of yearbooks. Although a significant portion of these records has been lost due to wars, 3,045 vols for 271 years (1623–1894 CE) have survived. In Korea, the *Seungjeongwon ilgi* is respected as an invaluable, rare References

Another Joseon record examined in this study is *Joseon wangjo silrok* (Annals of the Joseon Dynasty) that is also listed in UNESCO's Memory of the World registry. It is the chronological record of 25 Joseon Dynasty Kings, spanning a period of 472 years (1392–1863 CE). Several copies of *Joseon wangjo silrok* were printed with wooden movable type and then maintained at different archives. The total number of the *Joseon wangjo silrok* books stored at Seoul National University is 1187. The databases of *Seungjeongwon ilgi* (National Institute of Korean History, 2015) and *Joseon wangjo silrok* (National Institute of Korean History, 2007) records have been digitized and maintained by the National Institute of Korean History (2007, 2015).

2.2. Searching, compiling, and analyzing the records

Joseon kingdom officials were obligated to report to their superiors when they were physically incapable of carrying out their normal duties. We anticipated that if there were severe bone injuries occurring among the Joseon people, the records might still remain in *Seungjeongwon ilgi* and *Joseon wangjo silrok*. We searched the database for records of bone trauma using relevant keywords in order to identify textual examples of the injuries in these two collections of documents. The keywords related to the various events that could cause the bone injuries are *Jeolgol* (broken bone; fracture); *Jeolgak* (broken leg; fracture in the leg); *Jeolbi* (broken arm; fracture in arm); *Sanggak* (leg injury); *Sangbi* (arm injury); *Wigol* (dislocation); *Jeolsang* (broken injury; fracture); and *Nakma* or *Chuma* (falling off a horse).

Each such case was then compiled in accordance with the type of accident and the location of the injuries, referencing the frequencies of traumatic lesions by anatomical region in the reports on the injuries of North American individuals who engaged in a high risk professional rodeo (adult male; in 1981–1990; N = 181) (Andrews, 1992; Berger and Trinkaus, 1995), as well as patients with horse-related trauma from Sweden (both sexes, adult; in 2003–2004; N = 169) (Altgärde et al., 2014) and the United States (both sexes, all ages; in 2002–2004; N = 1430) (Loder, 2008). We used the package ggplot2 implemented in package R version 3.4.0 (R Foundation for Statistical Computing, Vienna, Austria) (Agresti, 2007) to draw charts for displaying multivariate injury data in each group (Wickham, 2009). The function geom_polygon implemented in ggplot2 (Wickham, 2009) was used to

draw graphs.

We performed Pearson chi-square tests for independence or Fisher's exact test to examine differences in injuries of head (including the neck), trunk and extremity between the samples using function `chisq.test` or `fisher.test` implemented in package R version 3.4.0 (R Foundation for Statistical Computing, Vienna, Austria) (Agresti, 2002; 2007). The difference in injuries of the upper and lower extremities was also statistically demonstrated by Pearson chi-square test for independence (categorical variables). Data were also analyzed with function `chisq.test` of package R.

3. Results

With the keywords *Jeolgol*, *Jeolgak*, *Jeolbi*, *Sanggak*, *Sangbi*, *Wigol* and *Jeolsang*, a considerable number of bone injury cases were identified in the *Seungjeongwon ilgi* and *Joseon wangjo silrok* (n = 188). According to the records, the causes and mechanisms of the injuries were diverse. Joseon people's bones were often broken because of a simple fall from a height (n = 41), torture during interrogation (n = 8), assault and beating during a fight (n = 23), or injuries during war and natural disaster (n = 3), though the cause was not specified in some cases (n = 19). We found numerous records relating to horse-riding accidents (n = 94), greatly overwhelmed other causes, making up 50% of the total.

We then searched keywords *Nakma* or *Chuma*, which means falling off a horse in medieval Korean. This search turned up hundreds of records about horse-riding accidents (n = 376). Indeed, the summary for the period 1625–1872 CE indicates that equestrian-related accidents were reported almost every year (Supplementary Data 1). Each such case was then compiled in accordance with the type of accident and the location of the injuries. In general, the Joseon records provide only brief or general descriptions of horse-riding accidents and the attendant injuries. As for 62.23% (234/376) of horse-riding accidents in this study, we could not discern the injured body part. However, some of the records (37.77%, 142/376) offer comprehensive and detailed data even by the standards of modern clinical reports.

Briefly, the extremities followed by the trunk and head were the body part where injuries occurred most frequently among Joseon casualties of horse-riding accidents. Among the Joseon cases with apparent traumatic profiles (n = 142), 113 (79.58%), people had injuries to their arms and/or legs, while the injuries to the trunk and head were 34.5% (49/142) and 4.92% (7/142) respectively (Supplementary Data 1). We also observed more injuries to the lower extremities (62.68%, 89/142) than to the upper extremities (29.58%, 42/142). The difference was statistically significant ($X^2 = 29.983$, $p = 4.359\text{E}-08$).

Our data referenced the anatomical distribution of the trauma lesions in from the rodeo samples (Andrews, 1992); the patients with the equestrian-related injuries from Sweden (Altgärde et al., 2014) and United States (Loder, 2008) were also considered for comparison (Table 1). The results are summarized in a radar chart (Fig. 1). According to chi-square and Fisher's exact tests, Swedish horse rider

Table 1
Comparison of the frequencies of head/neck, trunk and extremity injuries between the samples.

Locations of injuries	Equestrian-Related Injury in Modern Clinical Reports			Current Joseon Historical
	Rodeo ^a	Altgärde ^b	Loder ^c	
H&N	39.2	16.6	23.8	4.92
Trunk	9.9	28.9	28.9	34.5
Extremities	50.8	54.4	46.1	79.58

^a Andrews (1992).

^b Altgärde et al., (2014).

^c Loder (2008).

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