HÁSKÓLI ÍSLANDS
HUGVÍSINDASVIÐ

Break a leg

Bone fractures in Icelandic archaeological records

Ritgerð til BA í fornleifafræði

Haraldur Þór Hammer Haraldsson

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Háskóli Íslands

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Abstract

The aim of this thesis is to catalogue and categorize fractures from four different archaeological sites in Iceland, all from different periods in time. The information gathered has been put into chronological perspective with statistics such as individuals age at death, sex and side of the body affected by fracture. Both quantitative and qualitative research methods were used to find correlations between the sites, age of individuals, sex and side of the body affected by fractures will be discussed, along with specific cases and fractures. Most frequent fracture within each category were assessed to see if there are certain fractures that occur more often than in other categories. Fractures to each bone or bone group were described then linked to the fracture sample compiled for this thesis. The results showed no discernible correlation between sites, but yielded interesting information, especially that no rib fractures were observed from the site that represented the Middle-Ages. Further pathological analysis will have to be conducted in order to gain a more comprehensive understanding of the manner of how fractures occurred to the people of Iceland from its very settlement to early modern times.

Introduction

Humans are and have always been mobile creatures, even highly mobile, capable of travelling great distances and through almost every environment this planet has to offer. It also does not take much force to break human bones. Based on these two statements it can be expected that people have had accidents and suffered fractures.

If you ask any person you know, odds are that they have suffered at least one bone fracture in their lifetime, but if you ask multiple people, what you might hear are stories of many types of fractures, caused by different situations. The author of this thesis has suffered from three fractures, each afflicted in different circumstances and at different times in his life, well, with the exception of one phalange, where it fractured three times during one summer due to poor goalkeeping skills. Another time a left metacarpal suffered a complete fracture as a result of an impact with a glass window, where the window did not break but the victim suffered a broken hand and a broken pride. The third fracture was from a fall from the great height of a wheelchair which resulted in a fracture of the femur. It must be admitted that the fall was induced by a drug delirium (strong painkillers), but that is another story. Here is an example for how only one person can suffer from multiple fractures from many different array of reasons during only a short period of time. It is therefore likely that people in the past had similar experiences during their lifetime, all of which can sometimes be observed in the skeletal remains.

The aim of this thesis is to try to evaluate what are the most common bone fractures in Icelandic archaeological records, based on information from four sites from different time periods. The data will then be used to give probable insight into how these fractures happened and what possible activities these people were involved in at the time.

In this thesis data will be compiled from four archaeological sites, Skriðuklaustur, Skeljastaðir, Viðey and Reykjavík, which differ in chronological time, where fractures will be documented and put into perspective with age, sex and which side of the body each fracture occurred. The purpose of this work is to attempt to assess the frequency of fractures in the total skeletal assemblage from these four sites and to see if there is a correlation in fracture types or specific bone fractures through time. This research was based on a mixture of both quantitative and qualitative methods in order to unravel and understand the data available and the information that is possible to extract from it.

History of trauma classification

During the 19th century trauma was commonly divided into three categories: injury, anomalies and diseases (Matthews *et al.,* 1893; Whitney, 1886). For the purposes of this thesis we will be focusing on the first category of this classification: Injury, namely fracture. One of the first people to academically catalogue/register fractures and dislocations as injuries was William F. Whitney in 1886 (Whitney, 1886). Through the 19th and 20th centuries, bioarchaeologists divided injury into either intentional or accidental trauma (Buikstra and Beck, 2006- see Ortner and Powell, 2006 for further citation).

Many archaeological sites excavated in Iceland have uncovered skeletal remains. Most of them, whose preservation allowed to, have been analysed with consideration to age, sex and various pathologies. Paleopathology is a fairly young discipline in Iceland, and up to the 1980s most researchers who studied ancient skeletal remains were doctors. The man who studied the most remains was a doctor named Jón Steffensen (Kristján Eldjárn, 1988). After him came the osteologist Hildur Gestsdóttir, who is now currently applying paleopathalogical analysis to many of the remains previously studied by Steffensen and various other researchers. Many other osteologists and paleopathologists have studied remains found in Iceland in recent times, many of which researched the remains found at Skriðuklaustur and Hofstaðir. Due to the lack of funding, in some cases, many remains from other sites such as Reykjavík, Skeljastaðir and Viðey – that were chosen beside Skriðuklaustur as subjects for this thesis – have as of yet been fully pathologically analysed, but with dedicated work and the hope of a more prosperous times ahead this might change.

Bioarchaeological Background

Fractures and trauma have most likely afflicted human beings from the very beginning. One of the earliest recorded trauma dates back to the Pleistocene. A skull was found in June 1958 in a karst cave at Lion rock in the Maba town in China. The fossilized skull showed evidence of a blunt force trauma to the frontal bone of the cranium. Differential diagnosis suggest that either this lesion, which is semi-circular in appearance and shows signs of healing, are likely to have been produced by a fall or similar impact, or more probably another human being, via a hit with an object to the head. The Maba man, as this person has been called, survived this incidence for at least several months, according to the remodelling of the cranial vault and raised anterior margins (Wu, X. *et. al.,* 2011). Although the case of the trauma suffered by Maba man was plausibly caused by another human not all traumas stem from interhuman relations.

Fractures have been documented from the early Palaeolithic, in the remains of a *homo erectus*, found in China. Fractures have also been observed in remains of *homo sapiens* from the Middle and Upper Palaeolithic. According to Ortner (2003), the major cause for trauma and fracture in ancient times were the result of intentional violence. "Parry" types of fractures seem quite common in ancient remains, like from the remains found in the Eastern Mediterranean and Nubia.

Fractures have been documented from all other time periods in works too numerous to cite in this thesis, but it is clear that as long as there has been a reason for anyone to do anything, fractures have occurred. But fractures are not all alike, and differ from bone to bone and from trauma to trauma. Some fractures occur because of an underlying disease while others are the result of violence. Perhaps the most frequent fractures occur from simply falling. Discerning a fracture from other forms of pathologies, such as disease, stress, tissue injury or dislocations, can sometimes be a difficult process. Below, some of the signs which can be observed in bone that can resemble fractures will be discussed.

Entheseal changes

Porous ridges on the bone, where no fracture is noticeable. Destruction of fibrous bone tissue. These strange formations are called Entheseal changes. Entheseal activity are sometimes called enthesophytes, enthesopathies or enthesiopathies, and refer to new bone formation in the muscles (Roberts and Manchester, 2010; Grauer). This new bone formation sometimes takes the form of woven bone, referred to as bone spurs (Henderson, 2008). Trauma to attachment sites, such as where muscles, tendons and ligaments connect to a bone surface can lead to Entheseal changes. These changes are also sometimes referred to as Musculoskeletal Stress Markers (MSM) and can be described as bone build-up or destruction where muscles, tendons and ligaments connects to bone, and often look like lytic lesions (Henderson, 2008; Henderson *et.al,* 2013). Entheseal changes are categorized down to two main morphologies, although many variations exist between the two. These categories are fibrocartilaginous and fibrous enthesis and this classification is derived from the anatomical structure of the sites afflicted by these changes (Grauer, 2012).

Entheseal changes are suggested to be connected to physical stress, like overloading to the muscles. Studies of enthesophytes focus on activity-related stress on the muscle attachments on the bones, in the hope of deducting what activity past people used to perform (Henderson, 2008). The study with this goal first started in the 1980s. Through these studies it has been shown that Entheseal changes can be caused by various factors, most common of which being

acute trauma and disease, but also due to genetic, hormones, age, activities and others (Grauer, 2012; Roberts and Manchester, 2010). Of these factors, age is the best indicator for MSM (Cardoso and Henderson, 2010). This condition is not considered to be fatal in nature (Roberts and Manchester, 2010).

Entheseal changes can also occur due to disease (Henderson, 2008). Since these kinds of changes were not observed in the skeletal records on which this thesis is built, Entheseal changes will not be discussed in further detail.

Soft tissue ossification

For soft tissue ossification to be observed in skeletal remains, damage to the soft tissue must have touched or penetrated bone and started to heal. The bone can in some cases fully heal and show no evidence of injury, but the surrounding soft tissue can have ossified at the area of the injury. Lytic lesions may coincide with stress or strain to the soft tissue. An example of this can be found in the femur, more precisely in the postero-medial aspect at the distal regions. The most frequent of these lesions in modern times are cortical irregularities, most commonly observed in children and adolescents (Roberts and Manchester, 2010).

Injury to the flesh can result in ossification seen on the surface of the bone. Sometimes when trauma occurs, muscle tissue can produce bone inside the muscle itself, commonly in conjunction with hematoma. This condition is called traumatic myositis ossificans (Ortner, 2003).

Dislocations

Trauma to the joints is commonly referred to as dislocations. This type of trauma seems to be more frequent in two particular age groups than others, mainly in young and middle aged people (Lovell, 1997). Dislocations coincide with fractures, like Monteggia fracture-dislocation (Roberts and Manchester, 2010). There are a few types of dislocations. *Luxation* happens "*when the articular surfaces of a joint are totally displaced from one another"* (Lovell, 1997, p.140). Another form of dislocation is *subluxation,* which is similar to luxation, but the articular surface is partially displaced while retaining some contact to the opposing joint. Luxation and subluxation can happen in near all joints (Ortner and Putschar, 1981). The causing factors to dislocations can be congenital in nature, but the most common factors are traumatic (Lovell, 1997). When dislocations are observed, they are usually afflicted in the hip and shoulder joints. In some cases the dislocation can "reduce itself". This can mainly happen in so-called unstable

joints, such as in the shoulders, where the joint is already prone to dislocation (Roberts and Manchester, 2010).

When a dislocation occurs the articular cartilage can no longer receive nourishment from the synovial fluid (White and Folkens, 2005). This fluid gets its name due to its resemblance to the white liquid in an egg. The Synovial fluid acts as a lubricant for most joints (Mundt and Shanahan, 2010). When this lubricant is cut off from the cartilage it will deteriorate and arthritic changes will follow (White and Folkens, 2005).

The joint where the humerus meets the scapula is quite loose, weak and not as well protected against dislocations, therefor ill equipped to ward off traumatic dislocations (Ortner and Putschar, 1981; Ortner, 2003). If a dislocation goes untreated for a long time it can attribute to bone changes, such as a secondary joint surface in a place where a joint should not be (Mays, 2010; Roberts and Manchester, 2010). Although dislocations can be of traumatic origins, and sometimes associated with or connected to fractures, they will not be discussed in further detail in this thesis.

Fractures

The first step to categorize fractures is to define what a fracture is. Fracture can be termed as "*any traumatic event that results in partial or complete discontinuity of a bone*" (Ortner and Putschar, 1981, p. 55). Within this definition fall any traumatic conditions that break the bone incompletely and completely (Lovell, 1997). In order for a fracture to occur there needs to be an abnormal stress applied to a bone. This stress can be dynamic, when a sudden and/or high stress is inflicted to the bone, or static stress, which is low in stress at first but gradually increases, resulting in a break of the bone. Fracture can be further described as "*a result of abnormal force of tension, compression, torsion, bending, or shear applied to the bone*" (White and Folkens, 2005, p. 312). Another factor can be pathological fracture. This type of fracture happens when the bone is predisposed or prone to a break due to weakening from an illness or sickness (Ortner and Putschar, 1981).

Open fractures are when the bone protrudes through the flesh. This is often caused by a high velocity impact or great stress forced upon the bone. Open fractures invite the risk of infection, which even in modern times is dangerous, but in ancient times, as in modern, open fractures can result in fatal infection (Roberts and Manchester, 2010). *Closed fractures* are all other fractures which do not cut through the flesh (Lovell, 1997; Ortner and Putschar, 1981). This is sometimes called a *compound fracture* (White and Folkens, 2005). All fractures belong to these

two categories (Roberts and Manchester, 2010). In archaeological context, these fractures are hard to distinguish due to the lack of flash in the majority of cases.

Direct trauma is when the point of impact breaks the bone (Miller and Miller, 1979). These kinds of fractures may result in transverse, penetrating, comminuted or crushing fractures in the bone. This has also been called *dynamic stress* (Ortner and Putschar, 1981).

Indirect trauma is when a fracture occurs at a point not directly associated with the point of impact (Miller and Miller, 1979). This kind of trauma may result in spiral, oblique, greenstick, impacted, burst, comminuted and avulsion fractures in the bone (Lovell, 1999).

Pathological fractures are fractures caused primarily by pathological changes in the body. Such factors can be diseases, metabolic disturbances, tumours and other forms of illness, osteoporosis for example. The bone is then in an already weakened state and prone to fractures (Ortner and Putschar, 1981; Lovell 1997; White and Folkens, 2005, Mays, 2010).

Common fracture types

It is not surprising, since there are normally 206 bones in the human body and that there are many, many ways in which each bone can be broken, due to exterior and/or interior forces, that there are a lot of fracture types. An array of fracture terminology is used to describe the most common fracture types. It must be noted that there are often two or more terms describing the same fracture, and this is due to the fact that there has still not been reached a universal agreement on what is included in the definition of trauma or how it should be recorded (Grauer, 2012). It is probably best to start with a description of the most simple fracture types and move to the more specific ones later on.

Direct trauma can cause several types of fractures, and here below are descriptions for a number of them:

Transverse fractures can be described as "*a line perpendicular to the longitudinal axis of the bone*" (Lovell, 1997, p.141). These kinds of fractures can occur for instance when a football player kicks at a long bone of another player with much force.

Penetration fractures occur when a large force is applied to a small area, such as from projectile points, spear heads, swords, axes, bullets etc. These fractures are caused by an outside force which penetrates the flesh and pierces the bone. These fractures can sometimes also be *compound fractures* (Lovell, 1997).

Comminuted fracture is a term used when the bone splinters and/or shatters (White and Folkens, 2005). Comminuted fractures are multiple complete fractures to the same bone, often caused by blunt force trauma of projectiles traveling at very high speeds (Lovell, 1997).

Crush fractures, according to Lovell (1997) are most commonly affected in the cancellous bone afflicted by a direct force, such as blunt force trauma. Being hit on the cranium with a baseball bat would certainly classify as a crush fracture. These types of fractures have sometimes been called *compression fractures*. Fractures of joint surfaces are often a result from compression (Ortner and Putschar, 1981). Crush fractures can be further categorized into three sub-types: depression fracture; crushing activity from one side of the bone, compression fracture; crushing activity from two sides of the bone, and pressure fracture; continuous crushing activity applied over a long period of time, for example the process of elongating the cranium in cultures like was done in Mesoamerica (Tiesler, 2012) or other cultures that preformed bodily alterations for beautification purposes (Lovell, 1997). One of the best example of a pure compression fracture can be found in the spinal column where most fractures of this kind occur (Ortner and Putschar, 1981).

Indirect trauma is another form of fractures seen in skeletal materials and is not as "clear cut" in terms of pathologic analysis. There are, as with direct trauma, many fracture types, and below some of the most frequent ones will be described.

Oblique Fractures can be observed as an angled line across the longitudinal axis of a bone. If the fracture is well healed it can often be confused with a spiral line (Lovell, 1997).

Spiral fractures are lines that, as the name suggests, spiral down and around the shaft of a long bone. This formation is caused by stress that is forced downwards on the longitudinal axis (Lovell, 1997). These kinds of fractures are sometimes termed as a *twisting fracture*, where it is described as when one end of a limb is fixed into position while the other end rotates. These kinds of fractures are common in people who suffer fractures in skiing accidents for example (Ortner and Putschar, 1981).

Greenstick fractures occur when applied stress to a bone causes it to bend or buckle. This type of fracture is most frequently seen in children, where the bones have not fully harden and are still "soft". In adults Greenstick fractures are commonly observed in the ribs (Lovell, 1997).

Impacted fractures, along with burst and avulsion fractures are less frequent types of fractures. Impacted fractures happen when two ends of bone collide with one another by an exterior force (Lovell, 1997). Impacted fractures can also happen when "*opposing forces are applied to bone in slightly different planes*" (Ortner and Putschar, 1981, p. 58). Impacted fractures have in cases been termed as *Sheer fractures* (Ortner and Putschar, 1981). Colles´ fractures are a type of impacted fractures, which will be described in more detail later in this paper.

Burst fractures solely occur in the spinal column and are closely related to compression fractures. They result from a vertical compression force. *Schmorls´s nodes* are an example of form of bursts fractures, which are often seen in archaeological skeletal assemblages (Lovell, 1997; Ortner and Putschar, 1981).

Avulsion fractures occur when a tendon, joint capsule or ligament tear off a part of the bone (Lovell, 1997). These types of fractures are often associated with osteochondritis dissecans (Ortner and Putschar, 1981).

Stress fractures are a result from repetitive force being applied to the bone(s). These fractures are sometimes called *fatigue fractures* (Wilson and Katz, 1969). A fracture produced by stress is observed as a line that is perpendicular to the longitudinal axis, which can be problematic to distinguish as a stress fracture of direct trauma, or transverse fracture. *Hairline fractures* are a type of stress fractures which are seen in the bone as a non-displaced line crack or line. This is hard to recognize in an unhealed fracture, but when a bony callus has formed it is more easily seen radiographically (Lovell, 1997)

Apart from these fractures described here above, there are other types of trauma which are sometimes found in archaeological skeletal assemblages. These traumas are associated with warfare or surgery and are called *cuts* which are a result of a sharp object that slices the bone (Mays, 2010).

Fracture by bone

According to Lovell the most common types of fractures are *„transverse, spiral, oblique, and crush fractures“* (Lovell, 1997, p. 141) which happen due to indirect or direct trauma. There are two other types of fracture, which occur but less commonly, are stress related fractures and fractures as a result from pathology (Lovell, 1997). Here below will be described the most common fractures in relations to which bone is afflicted.

Bone	**Most common trauma**	**Common fracture sites**	**Type of fractures**	**Notes**	**References**
Cranium	Direct trauma	Cranial vault, Spheniod	Linear, Crushing, Penetrating	Direct trauma leaves fracture lines, Stellate lines for example	Ortner and Putshcar, 1981; Lovell, 1997

Mandible	Mixed	Ramus, condyle, roots of teeth	Mixed	Fractures often appear at an angle or horizontally	Lovell, 1997
Vertebrae	Indirect trauma	Body	Schmorl´s nodes, Compression	Fractures due to stress or disease are also common	Lovell, 1997; Roberts and Manchester, 2010
Ribs and Sternum	Direct trauma	Fifth to ninth ribs	Stress fractures	Rarely observed, often due to violence or occupational duress	Lovell, 1997; Roberts and Manchester 2010
Clavicle	Indirect trauma	Junction of the middle and lateral thirds	Mixed	Most often due to a fall, either onto the shoulder or onto outstreched hands, often not treated	Lovell, 1997; Roberts and Manchester, 2010
Scapula	Direct trauma	Body, neck, acromion and caracoid process	Comminuted	Often damaged post mortem	Lovell, 1997; Roberts and Manchester, 2010
Humerus	Indirect trauma	Shaft, neck, greater tuberosity	Mixed	In case of direct trauma, impacts or blows can cause fractures in the greater tuberosity	Lovell, 1997; Roberts and Manchester, 2010
Ulna	Mixed	Olecranon, shaft	Greenstick, Monteggia fracture-dislocation	Olecranon fractures appear more often in adults, Greenstick more in children. Fractures to both ulna and radius cause retardation in bone growth	Ortner and Putshcar, 1981; Lovell, 1997; Ortner, 2003

Radius	Shearing trauma	Junction of the middle and lateral thirds	Galeazzi, Monteggia fracture-dislocation, Colles´ fracture	Galeazzi, Monteggia and Colles´ fracture are all associated with falling onto outstreched hands	Ortner and Putschar, 1981; Lovell, 1997
Pelvis	Indirect trauma	Superior and/or inferior ischio-pubic ramus	Mixed	Often associated with high speed car accidents	Lovell, 1997; Roberts and Manchester, 2010
Femur	Mixed	Shaft, trochanteric region, neck, condyle	Rotational fracture, impact, hip dislocation, complete separation	Most often seen in people of advanced age	Lovell, 1997
Patella	Mixed	Not specified	Mixed	Rare in archaeological assemblages, usually caused by direct or indirect trauma	Roberts and Manchester, 2010
Tibia and fibula	Direct trauma	Ends of bones, often both opposite ends	Mixed	Often seen in dancers and in motor-cycle accidents. If both bones are fractured it can cause retardation in growth	Crawford-Adams, 1983; Lovell, 1997; Ortner, 2003; Roberts and Manchester, 2010
Hand, wrist, ankle and foot	Mixed	Metacarpals, metatarsals, phalanges, scaphiod, triquetral, calcaneal, cuboid	Oblique fractures, avulsion fractures	Fractures in the scaphiod more often observed in young adults than in any other age groups	Lovell, 1997

Fracture etiology

Diseases which affect the bones, might contribute to fractures. Various diseases may produce unnatural loss of bone which can result in pathological fractures. This can be problematic in distinguishing between disease and trauma (Ortner and Putschar, 1981). Fractures are sometimes caused or happen due to predominant or underlying diseases. Such conditions can cause bones to be susceptible to fractures, when the inflicted trauma would not have resulted in fracture (Lovell, 1997). Fractures which occur due to underlying pathologies are sometimes called *pathological fractures* (Ortner, 2003).

Rickets is a metabolic disease which is caused by Vitamin D deficiency, and is mainly seen in children. Rickets leads to softening of the bone, making it prone to deformation or fracturing. Bending of the long bones is a common indicator of rickets, along with rachitic rosary on the ribs, which can be described as thickening between the costal cartilage and rib. In adults the bone will be more fragile and thinner, which can cause compression fractures in the vertebral column (Grauer, 2012).

Scurvy is another metabolic disease that is induced by lack of Vitamin C in the food intake, which will lead to degradation of osteoid activity and frailty of connective tissue structure. Scurvy can afflict individuals in every age category, but is most often observed in juveniles. This disease is often connected to changes in the soft tissue. To discern the presence of scurvy by eye can be very difficult, since the symptoms can be very similar to other pathologies, such as "*specific and nonspecific infections, tumors, trauma"* (Grauer, 2012, p. 404).

Osteoporosis is caused by an imbalance between bone build up and bone resorption. This condition can be seen as significant low bone mass and loss of density in the bone and results in retarded mechanical strength in the bone. Compression fractures, Colles´ fractures and fractures to the femoral head are signs of osteoporosis (Grauer, 2012).

A fact that must always be considered is that, as Ortner says, "*multiple lesions may not represent the same morbid process*" (Ortner, 2003, p. 37). This means that if there are more than one abnormality observed in the same skeletal remains they can be caused by different set of factors, be they from trauma or disease, a combination of the two, or a combination of different diseases.

Other forms of disease, such as leprosy, syphilis (venereal, endemic and congenital), tuberculosis, brucellosis, osteomalacia, Pagets´s disease just to name a few, can induce an abnormal state in bones which can make them more susceptible to fracture. Pathological fractures from these diseases, however, will be considered as a cause for the purpose of the

statistical analysis of the skeletal assemblages discussed later in this paper, although if diseases were present, they will not be specified.

The osteological paradox

In the study of bones, be they ancient or modern, researchers must always be aware of a concept known as the osteological paradox. Various factors can assist to skew osteological analysis and interpretation. A fact known as *selective mortality* plays a crucial part of the paradox, and refers to the natural fact which builds up all skeletal assemblages, the remains are of people who have died, or as Wright and Yoder so eloquently put it "[they] *are dead for a reason*" (Wright and Yoder, 2003, p.3). Therefor the sample osteologists and other researchers have to work with are just a small proportion of the population that could have been exposed to various infections and diseases. Some diseases are more likely to affect certain age categories with more severity than others, hence the skeletal population will be skewed towards that certain age group (Wood, Milner, Herpending, and Weiss, 1994; Wright and Yoder, 2003).

Another problem associated with the paradox is a term called *hidden heterogeneity*. This term refers to the problem of identifying factors which cause underlying susceptibility to disease, which can lead to death. These factors could stem from genetics, social status and the environment. Death of children is a part of this problem, since they are frail by nature (Wood *et.al,* 1994; Wright and Yoder, 2003).

Thirdly, *demographic nonstationarity* poses yet another problem. People do not stay stationary throughout their live. They travel, to the next farm or other continents, exposing themselves to different kinds of environment and various risks of diseases or infections. Along with migration of people, age-specific factors are also involved, such as childbearing age of women (Wood *et.al,* 1994; Wright and Yoder, 2003).

Methods and Materials

The material used in this thesis is from osteological and pathological studies conducted on skeletal remains from four archaeological sites in Iceland. These sites were chosen due to their place in chronological time, Skeljastaðir dates to the Settlement period, Skriðuklaustur was operational in the Middle-Ages, the remains from the cemetery in Reykjavík were dated to the mid-17th to mid-18th centuries and the ones from Viðey date to the late 18th to early 19th centuries.

To make proper comparison between these sites, both numerical and percentile difference will be offered. This will be done due to the imbalance of individuals in the sample for each site.

Standards

Due to the fact that the data for this paper was compiled from various researchers for different times which differ in methods and interpretation it is impossible to state with any certainty what standards they might have followed in their pathological analysis for the trauma discussed here below. It is possible however to give a description of what these researchers might have used as standards for their evaluation. Here is a check-list of sorts, which was put forth by Charlotte Roberts and Brian Connell, which helps researchers to catalogue trauma in skeletal remains:

- „*bone affected*
- *part of bone*
- *type of fracture (spiral, comminuted, transverse, oblique, greenstick, compression (eg vertebrae), depressed (eg cranial)*
- *the probability of it being simple or compound*
- *angular or spiral deformity*
- *apposition of the fracture fragments*
- *amount of overlap*
- *evidence of healing*
- *evidence of complications, eg non-union, pseudoarthrosis, necrosis or death of bone, secondary complications such as infection and joint disease – care in determining whether pre- or post-fracture*“ (Roberts and Connell, 2004, p. 37).

Applying standards like this helps various researchers who analyse skeletal remains, in this case trauma, to make comparison of skeletal remains from all manner of sites (Brickley, 2004).

Database

The database compiled for the purpose of this thesis derives from sites that differ in size samples and time periods. They were chosen with the hope of getting a sample size for each time period which would be sufficient to make a viable statistical analysis. All available skeletal records were examined and only fractures that were stated as caused by trauma were recorded. Dental fractures were also recorded only if they were stated to be caused by trauma.

The data garnered from each site was categorized down to sex, age groups, bones affected by fractures, side of body affected (left vs. right), position on the bone affected and healed or not healed. The type of fracture is not stated unless the researcher felt secure enough to classify

it by himself. Some fractures will be discussed and plausible differential diagnosis offered. All these categories can have a "not specified" entry, which can be due to several reasons, such as; they were not specified by the researcher or the researcher was unable to give a certain assessment.

Estimated age was categorized into 6 groups, <17, 17-25, 26-35, 36-45, 45+ and Unknown adult. Under the definition of "Unknown adults" are those individuals which received classification by the examiner which were too broad for the groups above, or simply just unknown. Sex estimations were classed as male, male?, female, female? or unknown. For those who have a question mark represent those remains which were classified as possibly being male or females, but these categories (with "?") are only from the skeletal assemblages from Skriðuklaustur (Sundman, 2011).

These categories will then be used to find correlations between fractures and sex, age and time periods. Activity will then be speculated and estimated with relations to the suffered fractures. Frequency of fractures will be determined and discussed later in this thesis. Here below each individual site will be described along with the skeletal database associated with it.

Case studies from Icelandic Sites

For the purpose of this thesis, four skeletal assemblages where chosen to cover most of the period of inhabitancy of Iceland. Skeljastaðir dates to the settlement period, which fell into ruin after a great volcanic eruption in 1104. Skriðuklaustur was a monastery which also served as a hospital from the 14th to the mid-15th century. Viðey and Reykjavík held remains from late 18th to 19th century. The largest assemblage comes from Skriðuklaustur, 204 remains, whilst the smallest comes from Viðey, 17.

Here below each site will be described along with the statistics in regards to fractures sustained by the individuals of each site. At the end of the chapter all sites will be assessed as a whole and the total fracture sample will be detailed.

Introduction of Skriðuklaustur

This Catholic monastery was built in 1493 on the land called Skriða that is situated in Valþjólfsstað in Fljótsdal, which is in the east of Iceland. Skriðuklaustur was run and inhabited by monks of the order of Augustine and it was a dedicated hospital for the sick and impaired (Steinunn Kristjánsdóttir, 2012). At its height there were probably a dozen men and women working there with maintaining the household, garden, cooking, laundry, making medicine and the most important function of the monastery; taking care of around 200 patients which the spacious rooms and other items garnered from the 10 year archaeological investigation suggest. Skriðuklaustur served as a monastery and a hospital most likely until 1554, when it was closed

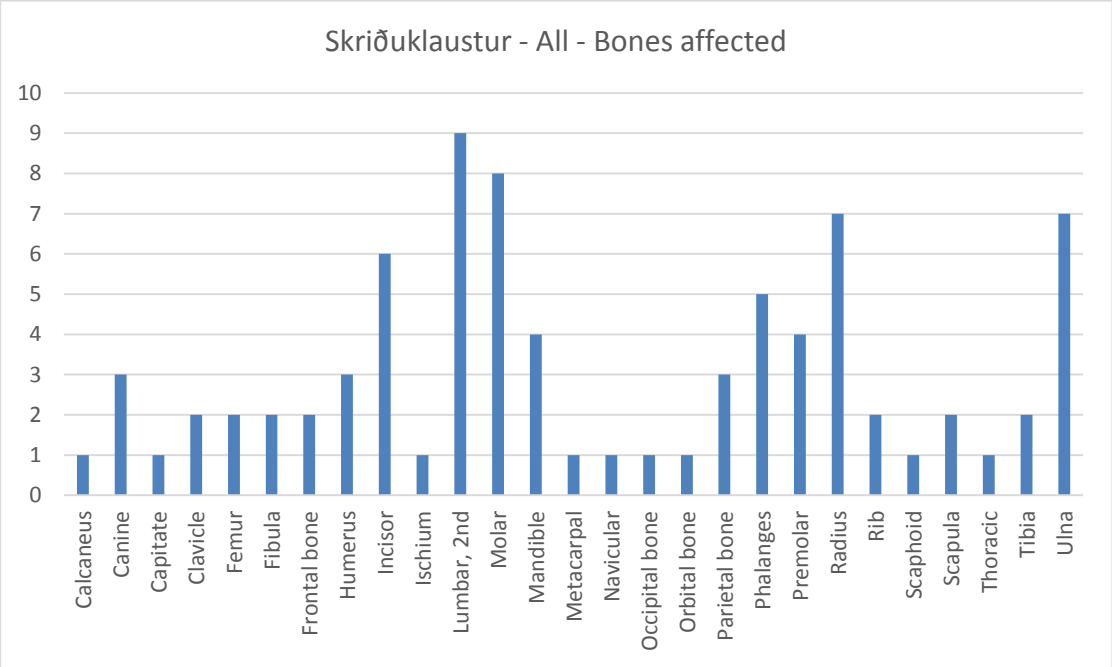

Table 1: All bones which sustained fractures in the skeletal assemblage from Skriðuklaustur

(Steinunn Kristjánsdóttir, 2012).

The archaeological investigation, led by the Icelandic archaeologist Steinunn Kristjánsdóttir, was conducted from 2002-2012. 295 graves were observed at the site, though 91 of them were not be considered for this sample. This is due to the fact that most of the 91 remains were from infants or foetuses, making them too young to sustain any observable fractures. 25 of these 81 graves were empty. Some of these remains were too poorly preserved to be analysed properly. Therefor only 204 remains are considered available for this fracture sample (Hawtin, 2006; Pacciani, 2006; Zoëga, 2007; Pacciani, 2009; Brandt, 2010; Collins, 2010; Ricci, 2010; Pacciani, 2010; Collins, 2011, Sundman, 2011 and Steinunn Kristjánsdóttir, 2012).

Statistics from Skriðuklaustur

270 skeletal remains were excavated over the duration of the project and each and every one of them examined and analysed for pathological conditions, both in the bones and teeth. Often only the teeth were preserved or very fragmented bones. Age and sex estimation was given, along with stature (height). From the whole sample there were 69 males, 79 females and 57 with undetermined sex. Age estimation for the whole sample was not considered, but as stated above, it was considered for the compiled database of fractures from Skriðuklaustur.

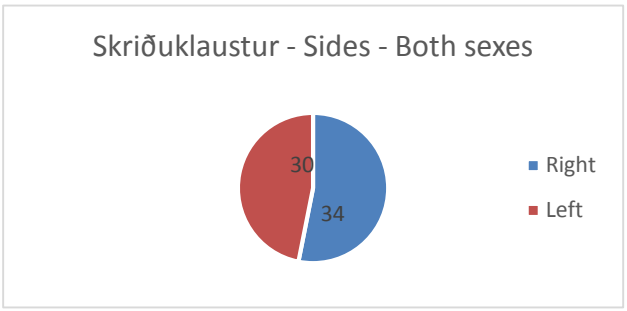

Table 2: Which side of the body was affected by a fracture in Skriðuklaustur.

In our fracture sample there were 45 individuals with 82 fractures. Of the 204 remains for our total available sample 22.05% suffered fractures. Of these 45 individuals, 22 were classified as male, 20 as females and three were undetermined. The most common age category was "45+", the least being "<17". The most frequent fracture documented from Skriðuklaustur was found in the lumbar vertebrae (9 cases), followed by molar fractures (8 cases) and fractures to the radius and ulna (7 cases each). Fractures in other bones were less frequent, see table 1 for further details. When divided into male and female, the most prominent fracture recorded in males were in the molars (5 cases), followed by radius and ulna fractures (4 cases each). See table. According to the fractures

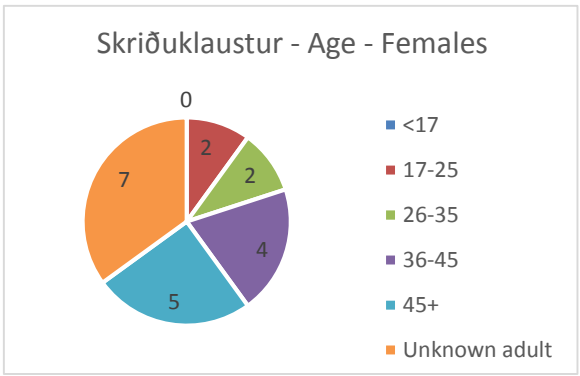

Table 4: Age caterogies for the females in the fracture sample from Skriðuklaustur.

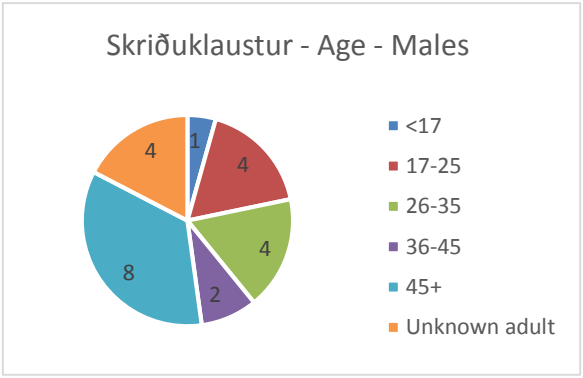

Table 3: Age categories for the males in the fracture sample from Skriðuklaustur.

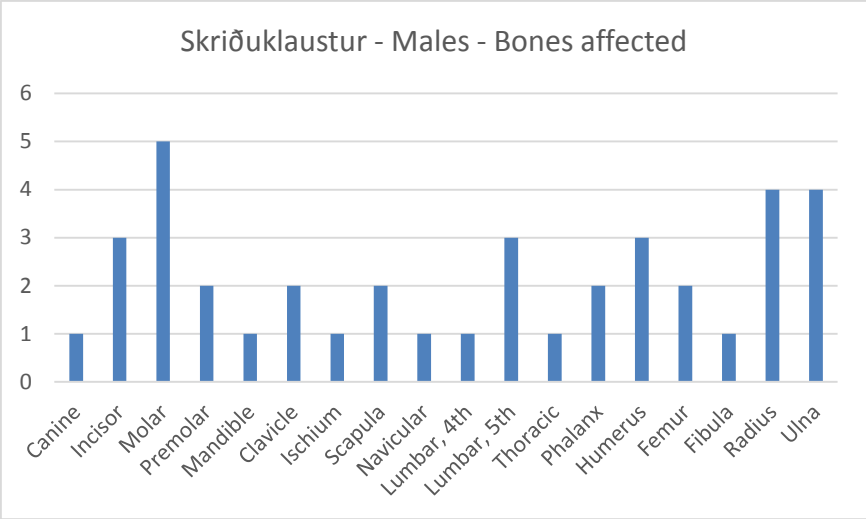

Table 5: All bones which males sustained fractures in the skeletal assemblage from Skriðuklaustur

sustained by the females in Skriðuklaustur the most frequent fracture was in the lumbar vertebrae (5 cases), with fractures in the incisors, mandibles, phalanges and radius coming second (3 cases for each bone), see table 6. Most common age category for the sexes in the fracture sample was "+45" for both sexes, or 38% for the males and 25%, for females, see tables 3 and 4. When the bones were sided in the body, 31 fractures afflicted bones in the left side, while 35 in the right, see table 2. In the case of the long bone fractures, six were sided to the left, and 17 to the right. All other bones were also more often sided to the right except in the teeth, where 15 fractures occurred on the left side, and four on the right.

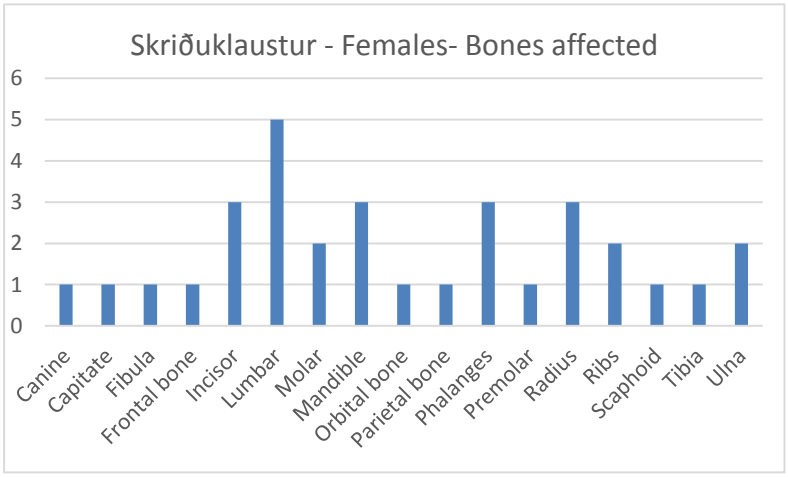

Table 6: All bones which females sustained fractures in the skeletal assemblage from Skriðuklaustur

When put into perspective to the whole sample of 204 skeletal remains, 10.8% of the males and 9.8% of the females suffered fractures and when compared to the corresponding sex, 31.9% of the males sustained fractures and 25.3% of females.

Introduction of Skeljastaðir

The site of Skeljastaðir, situated in Þjórsárdalur in the southern upland plains in Iceland, was inhabited from the settlement period to the 11th century. There are no written records about a cemetery at Skeljastaðir until 1709, where the reference is unfortunately vague (JÁM II, 1918-

1921). It is commonly thought that habitation in Skeljastaðir was abruptly ended following the violent volcanic eruption of Mount Hekla in 1104. However, a research that was conducted at Stöng, a settlement also in Þjórsárdalur, suggests that the valley was, probably in some areas, habituated until the 13th century (Vilhjálmur Ö. Vilhjálmsson, 1988).

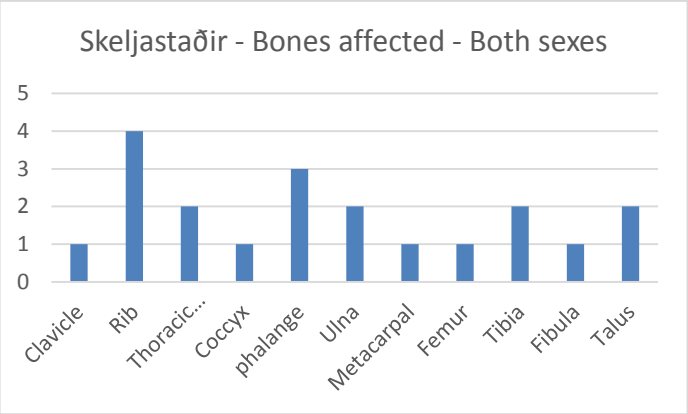

Table 7: All bones which sustained fractures in the skeletal assemblage from Skeljastaðir.

The cemetery at Skeljastaðir was first excavated in 1931 by an amateur archaeologist, Árni Óli, whose main profession was journalism. He brought several skeletons to the National Museum of Iceland later that summer and those bones were analysed by Dr. Jón Steffensen. In his observation he did not mention any trauma sustained by these people (Jón Steffensen, 1975).

The first archaeological excavation was conducted in 1935 by Eiður Kvaran, who found 20-30 skeletons, but due to unknown reasons, these remains were lost after he moved to Germany and died in 1939 (Sigurður Þórarinsson, 1968). The sites final excavation was done in 1939 by the antiquarian Matthías Þórðarsson, where the farm and the rest of the cemetery was dug up. The cemetery yielded 63 skeletons (Mattíhas Þórðarsson, 1943). Of these 63 remains, 56 are now preserved at the National Museum of Iceland, and as of yet, 7 of them have been osteologically analysed in 1999 and 53 in 2003 (Hildur Gestsdóttir, 1999; Hildur Gestsdóttir, 2003).

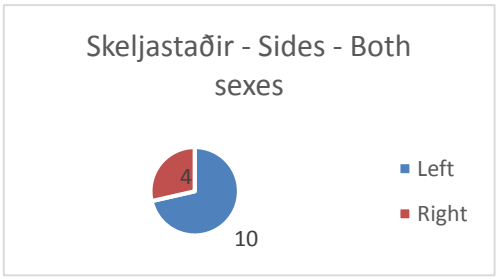

Table 8: Which side of the body was affected by a fracture in Skeljastaðir.

Statistic from Skeljastaðir

Out of the 53 remains that were pathologically analysed, 20 fractures were observed in 12 individuals, meaning that 22.6% of the individuals of the sample suffered fractures. All of the remains were assigned a sex, five were male and seven female. The most frequent age of the fracture sub-sample was “45+” and the least being “17-25”. Most of the fractures were sustained by the older people, or 85% of everyone older than 36 years old.

The most frequent fracture documented from Skeljastaðir was found in the ribs (4 cases), followed by fractures in the thoracic vertebrae (3 cases) while fractures in other bones were less frequent. When divided into male and female, the most prominent fracture recorded in males were in the ribs (3 cases), followed by talus fractures (2 cases each). According to the fractures sustained by the females in Skeljastaðir the most frequent fracture was in the phalanges (3 cases), with fractures in the thoracic vertebrae (2 cases for each bone).

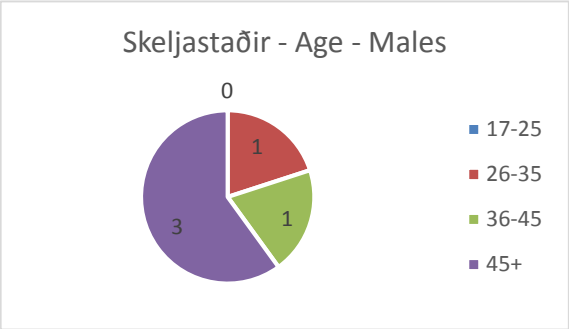

Table 9: Age caterogies for the males in the fracture sample from Skeljastaðir.

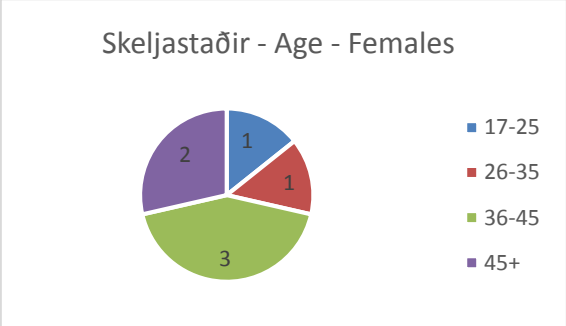

Table 10: Age caterogies for the females in the fracture sample from Skeljastaðir.

Most common age category for each sex in the fracture sample from Skeljastaðir was "+45" for males, or 60% and "36-45" for females, or 42.9%, see tables 9 and 10. The most common age category for both sexes combined was "+45", or 41.6%. When put into perspective to the whole sample of 53 skeletal remains, 9.4% of the males and 13.2% of the females suffered fractures when compared to the corresponding sex. When the bones were sided in the body, 10 fractures afflicted bones in the left side, while four in the right.

Introduction to Viðey

Viðey is a small island just north of Reykjavík. Archaeological researchers have dated the earliest settlements there to around 10/11th century (Steinunn Kristjánsdóttir, 1995). There have at least five churches stood there over the centuries, including the one still standing there today, which was constructed in 1766. The cemetery was excavated during the summers of 1987 and 1988 by Margrét Hallgrímsdóttir. The excavations unearthed 71 graves in total, the earliest of which date back to the first church, which was probably built in the 12th century (Margrét Hallgrímsdóttir, 1989).

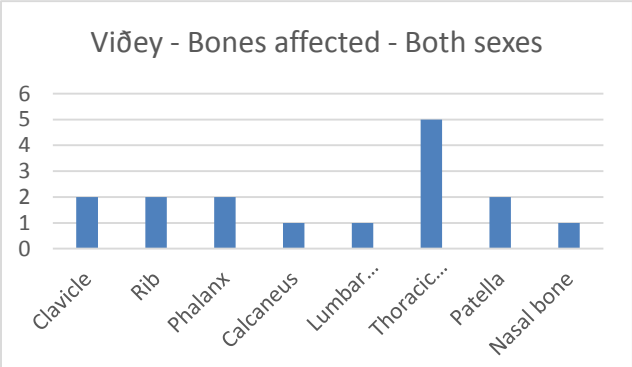

Table 11: All bones which sustained fractures in the skeletal assemblage from Viðey.

39 skeletal remains are now preserved at the Árbær Museum. 17 of them have been studied for age, sex and preservation and four of them had been pathologically analysed in 1999, and 10 in total by 2003 (Hildur Gestsdóttir, 1999; Hildur Gestsdóttir, 2003). These remains were estimated to be from the 18th and 19th century (Hildur Gestsdóttir, 2003).

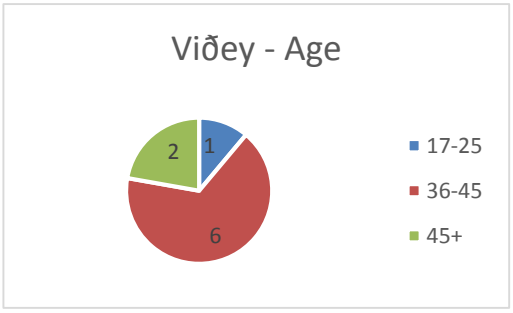

Table 12: Age caterogies for both sexes in the fracture sample from Viðey.

Statistics from Viðey

Out of the 17 remains that were pathologically analysed 16 fractures were observed in nine individuals, meaning that 52.9% of the individuals of the sample suffered fractures. All of the remains were assigned a sex, seven were male and two female. The most frequent age of the fracture sub-sample was "36-45" and the least being "17-25".

The most frequent fracture documented from Viðey was found in the Thoracic vertebrae (5 cases), followed by fractures in the Ribs, Clavicle and phalanges (2 cases each) while fractures in other bones were less frequent, see table 11. It is tentative to divide the fractures, age and fractures side down to sexes, since only two females' sustained fractures, in the Calcaneus and Patella.

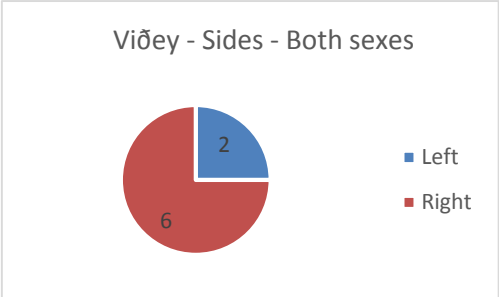

Table 13: Which side of the body was affected by a fracture from Viðey.

Most common age category for the sexes in the fracture sample was "36-45" (see table 12), or 41.6%, for the men. The females were assigned into the "36-45" and "+45". When put into perspective to the whole sample of 17 skeletal remains, 41.2% of the males and 11.8% of the females suffered fractures when compared to the corresponding sex. When the bones were sided in the body, two fractures afflicted bones in the left side, while six in the right, as depicted in table 13.

Introduction to Reykjavík

Hildur Gestsdóttir states that 99 skeletal remains from the Reykjavík Cemetery are currently preserved at the National Museum of Iceland which was recovered from three separate excavations. These excavations were done in 1940, 1960 and

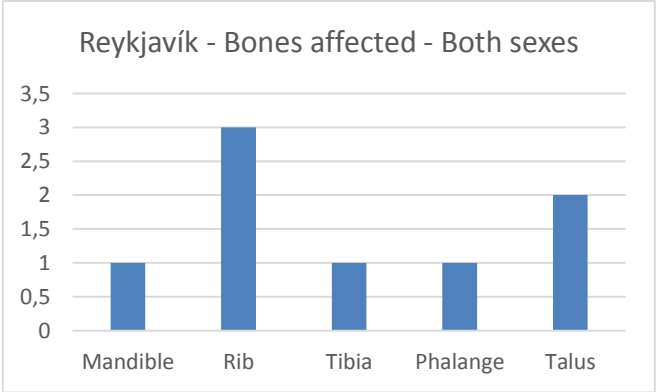

Table 14: All bones which sustained fractures in the skeletal assemblage from Reykjavík.

1967, but the remains from 1960, 82 remains, will not be discussed in this thesis since there has not been pathologically analysed, and out of the rest, 17, 7 showed signs of fractures, or 41% (Hildur Gestsdóttir, 1999).

The use of the cemetery was discontinued in 1838, when another cemetery was taken into use instead (Árni Óla, 1963). The remains have not been dated as of yet, so it is plausible that some of the remains could date as far back as the late 13th century, but it is more likely that they date to between 17th and mid-18th century, when the last church still stood there (Árni Óla, 1963).

Statistics from Reykjavík

Out of the 17 remains that were pathologically analysed, nine fractures were observed in seven individuals, meaning that 41.2% of the individuals of the sample suffered fractures. All of the remains were assigned a sex, five were male and two female. The most frequent age of the fracture sub-sample was "36-45" and the least being "26-35", see table 15.

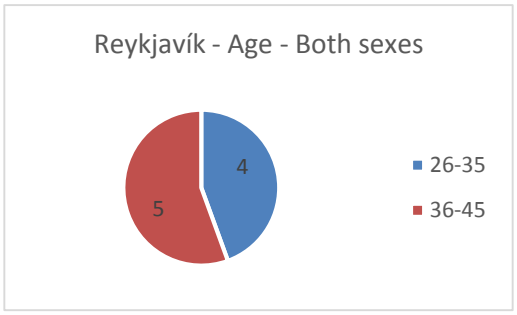

Table 15: Age caterogies for both sexes in the fracture sample from Reykjavík.

The most frequent fracture documented from Reykjavík was found in the ribs (three cases), followed by fractures in the talus (two cases) while fractures in other bones were less frequent, see table 14. It is tentative to divide the fractures, age and fractures side down to sexes, since only two females sustained fractures, in the ribs (two cases) and patella.

Most common age category for the sexes in the fracture sample was "36-45", or 23.5%, for the men. The females were assigned into the "26-35" and "36-45". When put into perspective to the whole sample of 17 skeletal remains, 29.4% of the males and 11.8% of the females suffered fractures when compared to the corresponding sex, see table 16. When the bones were sided in the body, three fractures afflicted bones on the left side, while five on the right. Multiple fractures were observed in one remains, who suffered three fractures, two rib fractures and one in the Patella (RVK-A-001).

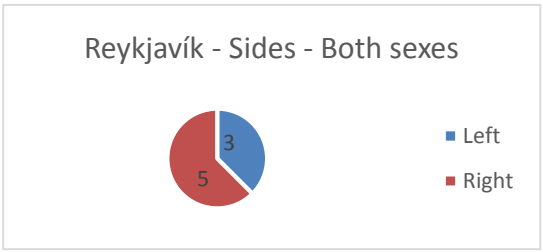

Table 16: Which side of the body was affected by a fracture from Reykjavík.

Results

Out of the total skeletal remains available to us, 291 (204 from Skriðuklaustur, 53 from Skeljastaðir, 17 from Viðey and 17 from Reykjavík) 72 individuals showed signs of fractures. In our fracture sample recorded 125 fractures. Of these 72 individuals, 39 were classified as male, 30 as females and 3 were undetermined. Multiple fractures were observed in 29 individuals. These remains had sustained at least two fractures, two of them had sustained five fractures (Graves 022 and 050 from Skriðuklaustur, which will be discussed in the next chapter). The most common age category was "36-45" with 21 cases, the least being "<17" with two cases, as depicted in table 17. The phalanges were the most frequent fracture in the whole fracture sample, with eleven recorded cases, followed by fractures in the lumbar Vertebrae, with ten cases, and ribs and ulna, nine cases. When the long bones were singled out, the ulna held the most common fracture total, or nine documented cases, followed by fractures to the radius, or seven cases.

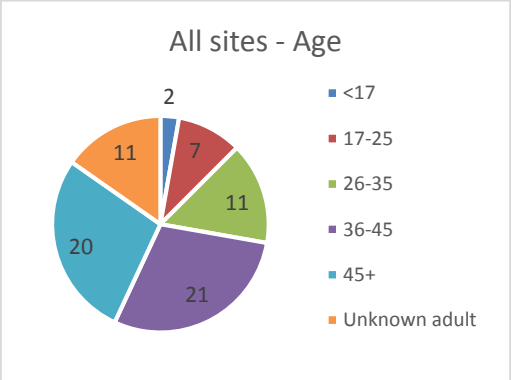

Table 17: Age caterogies for both sexes in the fracture sample from all four sites.

Below is a table which lists all bones from the fracture sample, along with the sides of the body affected and sexes.

Bone affected	Number	Left	Right	Other	Males	Females	Unknown
Calcaneus	2	1	1	0	0	2	0
Canine	3	3	0	0	1	1	1
Capitate	1	1	0	0	0	1	0
Clavicle	5	1	4	0	5	0	0
Coccyx	1	0	0	1	0	1	0
Femur	3	1	2	0	2	1	0
Fibula	3	1	2	0	2	1	0
Frontal bone	2	0	1	1	0	1	1
Humerus	3	0	3	0	3	0	0
Incisor	6	4	2	0	3	3	0
Ischium	1	1	0	0	1	0	0
Lumbar V.	10	0	0	10	5	5	0
Mandible	5	0	1	4	2	3	0
Metacarpal	2	2	0	0	0	1	1
Molar	8	5	3	0	6	2	0
Nasal bone	1	0	1	0	1	0	0
Navicular	1	0	1	0	1	0	0
Occipital bone	1	0	0	1	0	0	1
Orbital bone	1	0	1	0	0	1	0
Parietal bone	3	1	2	0	0	1	2
Patella	3	2	1	0	2	1	0
Phalanges	11	1	4	6	5	6	0
Premolar	4	4	0	0	3	1	0
Radius	7	3	4	0	4	3	0
Rib	9	4	5	0	6	3	0
Scaphoid	1	1	0	0	0	1	0
Scapula	2	1	1	0	2	0	0
Talus	4	3	1	0	3	1	0
Thoracic V.	8	0	0	8	6	2	0
Tibia	5	2	3	0	1	3	1
Ulna	9	3	6	0	5	3	1
Total	**125**	**45**	**49**	**31**	**69**	**48**	**8**

Table 18: Table of all fractures in the fracture sample, listed by bone, sides and sexes.

In other bones, the most frequent bone to sustain fractures in the total male fracture sample, were the phalanges, with eleven documented cases, followed by fractures to the ribs, with nine

cases. Fractures in other bones were less frequent. Most of the fractures in the sample occurred on the right side, 46 fractures, or 28 cases in males and 18 in females, as seen in table 18.

Fractures by age – all		Female	Male	Unknown
<17	8	0	3	5
17-25	13	5	8	0
26-35	19	8	9	2
36-45	33	15	18	0
45+	34	13	20	1
Unknown adult	18	8	10	0
Totals	**125**	**49**	**68**	**8**

Table 19: Fractures divided down to age categories and sexes.

The males sustain 69 fractures, while the females sustained 48, or in other words, the fracture rates of the sexes was 55.2% for the males and 38.4% for the females. Those categorised as unknown sustained 6.4% of the total fractures. In the male total fracture sample the most numerous fracture recorded was in the molars, or six cases, followed by lumbar, radius and ulna fractures, with four cases each. When the long bones were singled out, the ulna held the most common fractures, or five documented cases, followed by fractures to the radius, or four cases. In other bones, the most frequent bone to sustain fractures in the total male fracture sample, were the ribs, with six documented cases, followed by fractures to the phalanges and clavicle, with five cases each. Fractures in other bones were less frequent.

Fractures - side – all		Female	Male	Unknown
Left	45	18	23	4
Right	49	19	28	2
Center	24	10	12	2
Unsided	5	3	2	0
Not specified	2	1	1	0
Totals	**125**	**51**	**66**	**8**

Table 20: Fractures categoried into sides in correspondance with sides and sexes.

For the females, the most numerous fractures were recorded in the phalanges, or six cases, followed by lumbar fractures, five cases each. When the long bones were singled out, the ulna, tibia and radius held the most common fractures, or three documented cases each. In other bones, the most frequent bone to sustain fractures in the total female fracture sample, were the phalanges, with six documented cases, followed by fractures to the ribs, with three cases. Fractures in other bones were less frequent.

Let's consider each site as a representative for periods, Skeljastaðir for the settlement period, Skriðuklaustur for the Middle Ages, Reykjavík for the 17th to 18th century and Viðey for the 19th century. The most fractures to the cranium were observed in Skriðuklaustur, where one

person sustained fractures to the frontal, occipital, and parietal bones (Grave 022) and another to the frontal, orbital and parietal bones (Grave 081). Fractures to these bones where not observed in the other sites. Fractures to the ulna recorded in the skeletal assemblage in Skriðuklaustur measured 3.43% of the total sample of 204 remains, while in Skeljastaðir the same fracture measured 3.77% of the total sample of 53. No such fractures were observed in the assemblages from Viðey or Reykjavík. Fractures to the clavicle recorded in the skeletal assemblage in Skriðuklaustur measured 0.98%, 1.89% in Skeljastaðir and 11.76% in Viðey. Only one bone occurred in all four assemblages, phalanges. The percentile of fractures in the phalanges in Skriðuklaustur was 2.45%, in Skeljastaðir 5.66%, Viðey 11.76% and 5.88 in Reykjavík.

When side of sustained fractures in the body was considered for the total fracture sample, 35% of the fractures occurred on the left side of the bodies, while 40% on the right side. 14% of the males sustained fractures to left while 18% of the females sustained fractures on that same side. 25% of the males sustained fractures on the right side while 14% of the females sustained fractures on that same side.

Discussion

Below will be discussed some of the fractures documented and plausible reasons will be given on how these individuals sustained them. Lastly the results will be summarized and discussed with the consideration to sex and age.

Specific types of fractures

Seven individuals were observed to have fractures which showed no signs of healing. The only peri-mortem injuries, or two, sustained in the fracture sample discussed in this thesis came from Skriðuklaustur. Three other individuals from Skriðuklaustur had fractures which had not healed, and the last two came from Skeljastaðir and Reykjavík. These cases will be described and discussed here below.

The male in Grave 48 had a peculiar metal object imbedded into "*the anterior side of the head of the right humerus"* (Sundman, 2011, p. 45). The bone showed no signs of healing and object was not thought to be a nail from the coffin from which the remains was found in. This injury was therefor considered to be a peri-mortem trauma, but not as a cause of death. No other pathologies are counted by Sundman as a cause of death or peri-mortem, so one might think that this injury was sustained shortly after death, but this is only a speculation (Sundman, 2011).

It can be speculated that this injury was sustained due to violence, but there are no other evidence visible in the skeletal remains to support that theory.

The female remains from Grave 081 sustained injuries to the cranium, which left distinct marks on the bones. Two cut marks were documented, on the frontal and orbital and one mark was observed on the parietal bone, which was not stated to be from a cut. These marks had not healed, therefor they occurred sometime near her death. These fractures are very likely caused by intentional violence, so this 20-40 year old woman had either willingly or unwillingly engaged in violence and died either during or shortly after receiving this injury. She was also observed to have suffered from syphilis, and linking her condition to these injuries, although tentative, is an interesting one (Sundman, 2011). No one wants to suffer from syphilis.

One individual was diagnosed with Colles´ fractures, Grave 85 (Pacciani, 2009), and one other with a possible Colles´ fracture, Grave 130 (Pacciani, 2010; Collins, 2010). Both these remains come from the Skriðuklaustur excavation. A Colles´ fracture occurs when a person tries to break a fall with outstretched hands. The likely scenario for these fractures is falling from a horse, since horses were the most utilized form of transportation for the era, a second scenario would be simply stumbling during a run.

One individual was observed to have a Greenstick fracture, RVK-A-006 (Hildur Gestsdóttir, 2009). Since these fractures occur during the age when bones are still partly flexible, it most probably occurred during childhood. RVK-A-006 sustained this fracture to his left tibia, a bone between the knee and the calf. This type of fracture is often associated with injuries derived from a fall, like Colles´ fractures, but the fracture is different in that way that is results in more bowing of the bone. In this man´s case, falling from a horse at a young age is not unlikely, but other causes are also possible, like falling from a climb.

A young woman from Skriðuklaustur, Grave 179, (categorized to be 17-25 years old) sustained a compression fracture to the 5th lumbar, along with a fracture to three of her phalanges in the right foot. She was also observed to have arthritis. These phalange fractures were attributed to repetitive trauma "*such as that caused by an occupation or some form of habitual activity"* (Collins, 2008, p. 18). From the observation of these pathologies, it can be deducted that her life, as short as it was, could very well have been a difficult one. The fractures in her phalanges suggest a life of hard work on her feet, and the compression fractures in her lumbar indicate a fall, where she landed squarely on her feet, causing the vertebral column to compress, resulting in the fracture of, as stated above, the 5th lumbar.

Two oblique fractures, those caused by indirect trauma, were described in the total fracture sample. A 36-45 year old male from Skeljastaðir (ÞSK-A-016) had an oblique fracture in his

right tibia, which was stated to have been a very severe fracture and was healing at the time of his death. This fracture would have affected the man greatly, hindering him to walk unaided. The other case was observed in the remains of a 17-25 year old man in Viðey. He sustained an oblique fracture to an unsided proximal phalanx which had healed fully prior to death.

There was two fractures to the ribs documented in Skriðuklaustur (Grave 30), one of which was observed to be the result of disease. This raises several questions, like why? Skriðuklaustur served as a hospital, and it can be seen as strange that just one of the patient's sustained fractures to the ribs, while fractures to most other bones in the body were much more numerous. It must also be mentioned that Skriðuklaustur was the only site to observe fractures in the incisors. The questions raised by this can be; did these people eat something harder than in the other time periods? Were these fractures caused by violence? Further research might give inside into these strange facts.

It would have been interesting to document the sex for all individuals from the four sites to gain better understanding of the ratio between fractures and sex.

Females

When all the females are sorted by their age, most of them who sustained fractures were in the age group of 36-45 (nine individuals), followed by those who were unidentifiable (seven). Since it is logical to assume that people who are advanced in age have suffered more fractures then those who are younger, mainly due to the longer timeframe available to gain fracture, it can be assumed that females tended not to live longer than 36-45 years.

Males

When all the males are sorted by their age, most of them who sustained fractures were in the age group of 45+ (eight individuals), followed by those who were unidentifiable and 26-35 (four each). Therefore it can be assumed that males tended to live longer than females. The statistics from Skriðuklaustur, when the fractures sustained to the sexes is considered, it can be seen that males sustained fractures more frequently than females. This is an interesting result, which can raise questions about occupational hazards for males or even more tendency towards risk taking.

Limitations of this research

When looking through the statistical analysis of this paper, one thing becomes uncomfortably apparent, lack of information. The quality of the information available is quite satisfactory, but it's the quantity that is lacking, excluding the statistics from Skriðuklaustur. Due to this fact, all comparison across the sites is tentative, since the number of individuals from Skeljastaðir

(twelve), Viðey (nine) and Reykjavík (seven) are so much less then of Skriðuklaustur (204). This makes comparison within each site, excluding Skriðuklaustur again, also questionable since both the fractures and individuals are so few. Skriðuklaustur was by far the most analysed site of the four sites picked for this thesis. Due to that fact that the other sites have not yet been fully analysed, statistical comparison between all sites must be considered tentative at best.

Another limitation to consider is that some of the reports are still, as of yet, incomplete. Some of the sites have not yet been fully osteologically and/or pathologically analysed. The information from those further analysis would have had great value, but this lack of data can be caused by various reasons, such as insufficient funding's. Taphonimy and preservation also play a part in the limitation. The preservation of skeletal remains is often determined by the sort of environment they are in. Oxygen and acidic levels contribute to the preservation or destruction of bones, partial or complete, which affects statistical and pathological analysis (Grauer *et.al*, 2012; White and Folkens, 2005).

Conclusion

The oldest site of the total fracture sample for this thesis is Skeljastaðir and there the most observed fractures occurred in the ribs and phalanges. In Skriðuklaustur the most frequent bone to sustain fractures were the lumbars and molars, followed by the premolars, radius and phalanges. In the skeletal remains analysed from Viðey the most common fracture was in the thoracic vertebrae, followed by clavicle, rib, phalange and patella fractures, and from Reykjavík it were the ribs. From this data it can be assessed that in the Settlement period (Skeljastaðir) and the late 17th to 19th century, ribs and phalanges were more common fractures compared to the Middle-Ages (Skriðuklaustur). It is interesting to note that only one rib fracture was documented in Skriðuklaustur, while more rib fractures were observed in all the other three sites. Another interesting note is that the only site to have recorded fractures in the incisors was Skriðuklaustur.

Fractures to the ulna and radius, injuries associated with falling, were only observed in Skeljastaðir and Skriðuklaustur, sites that represent the earlier period of habituation in Iceland. This suggests that people living during Iceland's early history were more prone to falling than people during later periods. The phalanges were observed to fracture in all periods.

Further studies with regards to fractures must be done on the skeletal assemblages available in Iceland to gain a more coherent and complete understanding and insight into the habitual activities these past people engaged in during their lifetime.

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Appendixes

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 002	17-25	Male	Incisor	left	lateral, maxilla	fracture	Not specified	The maxillary left lateral incisor was fractured just above the cemento-enamel junction.	Collins, 2008
Grave 002	17-25	Male	Incisor	Right	Central	fracture	Not specified	The right central The right central incisor was also broken ante mortem, and the dentition in this part of the row was crowded.	Collins, 2008
Grave 004	Unknown adult	Male	Ischium	Left	Surface	Rough and irregual surface	Healed	Likely from falling. in fact the absence of morphological and insertional asymmetry between the lower limbs lets us exclude a specific activity involving mostly the left leg.	EASHUM_2011
Grave 010	45+	Female	Calcaneus	Left	Not specified	Not specified	Healed	Tip broken off, both surfaces mostly healed	Morgan, 2008
Grave 022	<17	Unknown	Tibia	Right	Poximal diaphysis	Unknown	Healed	At the proximal diaphysis, signs of infections which spread through the knee joint into the femur.	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 022	<17	Unknown	Frontal bone	Center	Right side in front of bregma	Depression	Healing	4 shallow depressions in the cranium. Frontal bone: 10,5x16,5mm size. Could be syohilis, also a head trauma, where the similar stage of healing indicates that all injuries are from the same occation.	EASHUM_2011
Grave 022	<17	Unknown	Parietal bone	Right	Medial side of the tuber	Depression	Healing	4 shallow depressions in the cranium. Parietal bone, right: 10mm diameter, medial side of the tuber. Could be syohilis, also a head trauma, where the similar stage of healing indicates that all injuries are from the same occation.	EASHUM_2011
Grave 022	<17	Unknown	Parietal bone	Left	By the middle of the sagittal suture	Depression	Healing	4 shallow depressions in the cranium. Parietal bone, left: 10mm diameter, middle of the sagittal suture. Could be syohilis, also a head trauma, where the similar stage of healing indicates that all injuries are from the same occation.	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 022	<17	Unknown	Occipital bone	Center	By the extrernal occipital protuberance	Depression	Healing	4 shallow depressions in the cranium. Occipital bone: 15x20mm in size, by the external occipital protuberance. Could be syohilis, also a head trauma, where the similar stage of healing indicates that all injuries are from the same occation.	Zoëga, 2007
Grave 030	45+	Female	Rib	Right	Not specified	fracture	healed	one rib from the right side has broken, but the fracture has healed fully	Zoëga, 2007
Grave 030	45+	Female	Rib	Left	11th rib	fracture	not healed	fractured at the emphesis at one end, not healed, probably due to infection	GZHUM_2007
Grave 043	17-25	Male	Lumbar, 5th	Body	Dorsal side of body	Collapse	Healed	Trauma on the lowest lumbar. The trauma seems to be related to stress from repetetive motion, but trauma can not be excluded, resemble trauma from a fall.	GZHUM_2007
Grave 043	17-25	Male	Scapula	Right	Distal fracture from the medial line	Break	Healing	Trauma on the scapula. New bonegrowth is visible on the scapulas which indicate healing. Right scapula broken in two.	GZHUM_2007
Grave 043	17-25	Male	Scapula	Left	Not specified	Fractures	Healing	Trauma on the scapula. New bonegrowth is visible on the scapulas which indicate healing. Less	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
								fractured than the right scapula.	
Grave 048	45+	Male	Humerus	Right	Anterior side of the head.	Intrusive object	Not healed	There is an iron object, c. 3 mm in diameter, penetrating the anterior side of the head of the right humerus. Possibly peri mortem injury. Probably not a coffin nail.	EASHUM_2011
Grave 050	Unknown adult	Male	Mandible	Center	Inferior	Transverse groove	Healed	Transversal groove at the mental protuberance, 3 mm wide, with a rounded, U-shaped profile.	EASHUM_2011
Grave 050	Unknown adult	Male	Radius	Right	Distal part of diaphysis	Fracture	Healed	Distal parts of the diaphyses are swollen and have porous new bone formations. Trauma probably caused when the individual tried to break a fall with both arms.	EASHUM_2011
Grave 050	Unknown adult	Male	Radius	Left	Distal part of diaphysis	Fracture	Healed	Distal parts of the diaphyses are swollen and have porous new bone formations. Trauma probably caused when the individual tried to break a fall with both arms.	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 050	Unknown adult	Male	Ulna	Right	Distal part of diaphysis	Fracture	Healed	Distal parts of the diaphyses are swollen and have porous new bone formations. Trauma probably caused when the individual tried to break a fall with both arms.	EASHUM_2011
Grave 050	Unknown adult	Male	Ulna	Left	Distal part of diaphysis	Fracture	Healed	Distal parts of the diaphyses are swollen and have porous new bone formations. Trauma probably caused when the individual tried to break a fall with both arms.	EASHUM_2011
Grave 055	45+	Male	Clavicle	Right	Middle	Fracture	Healed	Clavical is shorter then the left due to a misaligned healed fracture. Facture accured at the middle, and the medial part overlaps the lateral part.	EASHUM_2011
Grave 055	45+	Male	M2	Right	Lower, distal side of crown	Fracture	Healed	Tooth 31, distal part of the crown is missing. Rounded surface of the break indicates that the tooth was fractured ante mortem.	EPHUM_2006
Grave 063	<17	Male	PM2	Left	Lingual side	Fracture	Not specified	A fracture occured ante mortem on the left maxillary second molar, lingual side.	EPHUM_2006

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 066	36-45	Male	Clavicle	Right	Not specified	Fracture	Healed	Markedly shorter than the left. Prominent thorn arises from the medial-lower-posterior edge, deribed by a degenerative ossification is obsereved. Such a kind of fractures can occur from habitual carrying of heavy objects on the shoulder.	EPHUM_2006
Grave 067	36-45	Female	Ulna	Right	Epiphysis	Fracture	Healed	A degeneration can be the long-term consequence of a fracture or a dislocation.	EPHUM_2008
Grave 080	17-25	Male	Incisor	Left	Lower	Fracture		Lower first incisor lost ante mortem due to fracture.	EPHUM_2008
Grave 080	17-25	Male	PM1	Left	Upper	Fracture		First upper premolars, left side. Suggestive of a crushing activity	EPHUM_2008
Grave 080	17-25	Male	PM1	Left	Lower	Fracture		First lower premolars, left side. Suggestive of a crushing activity	EPHUM_2008
Grave 080	17-25	Male	Canine	Left	Lower	Fracture		lower canine, left side. Suggestive of a crushing activity	EASHUM_2011
Grave 081	26-35	Female	Frontal bone	Right	diagonally anterior/laterally-posterior/medailly	Cut mark	Not healed	Cut marks in the right side of the frontal bone. A double cut mark is directed diagonally anterior/laterally-posterior/medailly. Parallel cuts. V-profile cuts.	EASHUM_2011
Grave 081	26-35	Female	Orbital bone	Right	Above	Cut mark	Not healed	Cut marks, just above the right orbit and almost	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
								sagittal in direction. U-shaped profile.	
Grave 081	26-35	Female	Parietal bone	Right	At the tuber	Mark	Not healed	Mark, at the tuber of the right parietal bone. Curved shaped. U-shaped profile. Probably not a cut.	EPHUM_2009
Grave 083	45+	Male	Thoracic	Body	Distal and Proximal	Degenerative	not healed	a severe degenerative, osteophytic area located between the 5th and 6th thoracic V. Probably due to trauma, as the adjacent vertebrae are more or less normal.	EPHUM_2009
Grave 084	26-35	Male	Lumbar, 5th	Arch	between upper and lower intervertebral joints	Break	Not specified	Bilateral spondylolysis, complete breakage of the vertebral arche at the istmo (region between the upper and lower intervertebral joints). Represents recurrent stresses or trauma.	EPHUM_2009
Grave 085	Unknown adult	Female	Radius	Right	Distal part of doaphysis	Colles fracture	Healed	Distal part of the doaphysis.well mended, without disalignment, but it was the cause of a secondary severe degeneration of the wrist joint. Right hand possibly impossible to use. Signs of overloading on the left hand.	EPHUM_2009

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 085	Unknown adult	Female	Lumbar, 3rd	Body	Left side of body	Hit	Ante mortem	whitish thin lamina with curved surface embedded into the body, passing through the cylinder in the boundery between the anterior and the left side, from the upper flat part of the lower one. No broken fragments or cracks, there for hit by a sharp item when still alive. Possibly cause of death. The bone displays no broken fragments or cracks, seems therefore hit by a sharp item.	EPHUM_2009
Grave 088	26-35	Male	Humerus	Right	Along the insertion of teres maior	Enthesopathy	Healed	Well defined and deep pit along the insertion of teres maior, whose meaning seems an enthesopathy of traumatic origin.	EASHUM_2011
Grave 091	26-35	Male	Femur	Right	Lateral	Distal diaphysis	Healed	Depression, oval, 10x20mm in size. Sides are smooth, indicating a healed injury, possibly a fracture or a soft tissue trauma. Could be a healed syphilitic lesion.	EASHUM_2011
Grave 112	36-45	Female	Incisor	Right	Central	Not specified.	Healed	Distal half of the crown is missing.	EASHUM_2011
Grave 112	36-45	Female	Incisor	Left	Central	Not specified.	Healed	Not specified.	EASHUM_2011
Grave 112	36-45	Female	Incisor	Left	Lateral	Not specified.	Healed	Not specified.	CCHUM_2010

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 126	Unknown adult	Female	Phalanges	Left	3rd proximal and middle phalanges	Traumatic arthritis	Healed	Ankylosis between the first and second phalanx, traumatic origin. Phalanges fused a 90° angle, perhaps due to malunion following a fracture.	CCHUM_2010, EPHUM_2010
Grave 128	Unknown adult	Female	Lumbar, 2nd	Body and arch	Superior side of the arch turned backwards and the inferior side forward	Compound Fracture	Not specified	Caused extreme stress on the upper limbs. She survived but could not walk, not even on crutches. Possibly moved around on a low wheeled cart. The 2nd LV shows a total fracture (arch and body), superior side of the arch turned backwards and the inferior side forward, till leaning against the body and even burying itself in it (EPHUM_2010). Kyphosis affected the cervical, thoracic and lumbar spine, diagnosis = tuberculosis (CCHUM_2010).	CCHUM_2010, EPHUM_2010

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 130	45+	Male	Femur	Right	Distal diaphysis	Colles fracture?	Healed	The adductor muscles of the femur were contracted by the fracture and thus caused shortening of the original length of the bone (CCHUM_2010). EP states that this is the left femur? distal diaphysis, 10 cm from the half. Callus and post-traumatic ossification are not particularly abundant. Certainly made trouble in the mechanical function of the lower limb. Probably walked on cruches for a time. (EPHUM_2010).	CCHUM_2010
Grave 138	Unknown adult	Male?	Phalanges	Right	First proximal and distal phalanges	Joint trauma	Not specified	Compounded with secondary arthritis. Could be the result of joint trauma, such as micro fractures. May be resultant to repetitive stress.	CCHUM_2010, EPHUM_2010
Grave 143	45+	Female	Scaphoid	Left	Not specified	Joint trauma	Not specified	The left scaphoid and capitate in particular evidenced some joint traum in the wrist with lesions (CCHUM_2010). scaphoid and capitate of the left side are swollen, perforated, porous, osteophytic and deformed (EPHUM_2010).	CCHUM_2010

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 143	45+	Female	Capitate	Left	Not specified	Joint trauma	Not specified	The left scaphoid and capitate in particular evidenced some joint traum in the wrist with lesions (CCHUM_2010). scaphoid and capitate of the left side are swollen, perforated, porous, osteophytic and deformed (EPHUM_2010).	CCHUM_2011
Grave 167	26-35	Male	M1	Left	Mandibule	Fracture	Not specified	Corresponds to fractures of the enamel of the maxillary left M2 and M3	CCHUM_2011
Grave 167	26-35	Male	M2	Left	Mandibule	Fracture	Not specified	Corresponds to fractures of the enamel of the maxillary left M2 and M3	CCHUM_2011
Grave 167	26-35	Male	M2	Left	Maxilla	Fracture	Not specified	Corresponds to fractures of the enamel of the mandibular left M1 and M2	CCHUM_2011
Grave 167	26-35	Male	M3	Left	Maxilla	Fracture	Not specified	Corresponds to fractures of the enamel of the mandibular left M1 and M2	CCHUM_2011
Grave 169	45+	Male	Navicular	Right	Not specified	Fracture	Not healed	A fracture of the right foot navicular and secondary arthritis would have caused some pain and discomfirt, the bone did not heal and remained bipartite.	CCHUM_2011
Grave 169	45+	Male	Lumbar, 4th	Body	Not specified	Compression	Not specified	L4 has compression fractures, likely due to occupation	CCHUM_2011
Grave 169	45+	Male	Lumbar, 5th	Body	Not specified	Compression	Not specified	L5 has compression fractures, likely due to occupation	GRHUM_2010

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 174	45+	Male	M3	Right	Upper	Not specified.	Healing	M3 most likely lost antemortem, signs of alveolar healing.	CCHUM_2011
Grave 179	17-25	Female	Lumbar, 5th	Body	Transverse	Compression	Not specified	5th. Compression fracture in the transverse body, with secondary arthritis present.	CCHUM_2011
Grave 179	17-25	Female	Phalanx	Right	Distal and middle right	Fusion	Healed	Fusion of a distal and middle right pha. Could be related to repetitive trauma, caused possibly by occupation or some form of habitual activity.	CCHUM_2011
Grave 179	17-25	Female	Phalanx	Right	Proximal	Puncture lesion	Healed	Puncture lesion on base of first proximal phalanx. Could be related to repetitive trauma, caused possibly by occupation or some form of habitual activity.	CBHUM_2010
Grave 183	45+	Unknown	Ulna	Left	Not specified	Bent	Not specified	left or right? Rickets?	CBHUM_2010
Grave 185	45+	Male	Fibula	Right	Not specified	Not specified	Healed	Information lacking	CBHUM_2010
Grave 185	45+	Male	Radius	Left	Not specified	Not specified	Healed	Information lacking	EASHUM_2011
Grave 187	Unknown adult	Female	Mandible	Center	Anterior	Fracture	Healed	A very broad and uneven outline, and the appearance of being cut off, or not properly aligned after a fracture. Could be a sign of a permanent disability, possibly partial	CBHUM_2010

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
								paralyses. Maxilla not presereved.	
Grave 191	17-25	Female	Fibula	Left	Distal turning medial	Not specified	Not specified	(pre or post mortem?) Rickets? Information lacking	CBHUM_2010
Grave 192	36-45	Male	Ulna	Right	Distal turning lateral	Not specified		(pre or post mortem?) Likely a fracture, according to the photo. Information lacking	CBHUM_2010
Grave 194	45+	Female	Ulna	Right	Distal	Fracture	Healed	Information lacking	CBHUM_2010
Grave 194	45+	Female	Radius	Right	Distal	Fracture		Information lacking	CBHUM_2010
Grave 194	45+	Female	Tibia	Right	Dorsal	Fracture	Healed	Thickend with a rough surface, possible infection	EASHUM_2011
Grave 197	Unknown adult	Female	Radius	Left	Distal	Fracture	healed	The left radius narrows for about 20mm in the distal third of the diaphysis, with some porous new bone formation. There is also a slightangle to the bone, indicating that this is a healed fracture.	EASHUM_2011
Grave 206	36-45	Female?	M1	Right	Broken in half, only mesial part present	Fracture	Healed	16th, first molar of the right mandible has been broken in half ante mortem. The resorbed alveolar bone is probably due to an	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
								inflammation related to the dental trauma.	
Grave 215	26-35	Female	Mandible	Center	Area under the first left incisor	Not specified	Healed	Reduction of alveolar bone, and the toots of the anterior teeth in the mandible are exposed. Possibly the missing central incisor was lost due to trauma. The large calculus depostits possibly built up after the injury.	EASHUM_2011
Grave 227	45+	Male	Phalanx	Right	Distal joint	Not specified	Healed	First phalanx of the right hand. Bump on the dorsal part of the lateral distal condyle. This bone formation, 5mm in size, was possibly caused by trauma.	EASHUM_2011
Grave 231	26-35	Unknown	Metacarpal	Left	Diaphysis, making the dorsal side convex	Not specified	Healed	Fourth metacarpal on the left hand. Slight angle to the diaphysis, making the dorsal side more convex. Probably slightly misaligned fracture.	EASHUM_2011
Grave 231	26-35	Unknown	Canine	Left	Crown, lingual part missing, lower	Not specified	Healed	33rd. The crown of the canine of the left mandible is fractured ante mortem, thin layer of calculus on the surface of the break.	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 232	Unknown adult	Female?	PM2	Left	Diagonal fracture	Not specified	Healed	15th. The second premolar of the right maxilla is fractured diagonally. The surface break is rounded, indicating ante mortem damage.	EASHUM_2011
Grave 234	36-45	Female	Canine	Left	Maxilla	Not specified	Healed	13th. Mesial part of the crown of the canine of the left maxilla was broken ante mortem, calculus covers the surface of the break.	EASHUM_2011
Grave 234	36-45	Female	M1	Left	Mandibule	Not specified	Healed	36th. The mesio-lingual cusp of the first molar of the left mandible was broken ante mortem. Surface is round and some calculus of the surface of the break.	EASHUM_2011
Grave 236	45+	Female	Lumbar, 4th	Body and arch	Left superior joint is attached to the body while the right superior joint and the inferior joints are attached to the arch	Fracture	Healed	4th and 5th LV exhibit bilateral spondylolysis, a stress fracture of the arch of the vertebrae. It can be caused by stress of the lower spine, but also by acute trauma, as a fall.	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 236	45+	Female	Lumbar, 5th	Body and arch	Both superior joints are connected to the body and both inferior joints connected to the arch	Fracture		4th and 5th LV exhibit bilateral spondylolysis, a stress fracture of the arch of the vertebrae. It can be caused by stress of the lower spine, but also by acute trauma, as a fall.	EASHUM_2011
Grave 238	Unknown adult	Female	Mandible	Center	Inferior site of left mental tubercle	Injury	Healed	Inferior side of the left mental tubercle. Shallow grove, 2mm wide.	EASHUM_2011
Grave 242	Unknown adult	Male	Humerus	Right	Fossa olecrani	Fracture	Healed	The fossa olecrani of the humerus is almost completely filled with bone. Mobility of the joint was restricted due to the new bone formation of the humerus, radius and ulna. Arm could probably not straighten more then about 90° angle.	EASHUM_2011
Grave 242	Unknown adult	Male	Ulna	Right	Proximal joint	Fracture	Healed	Lipping around the proximal joint, towards the radius. Mobility of the joint was restricted due to the new bone formation of the humerus, radius and ulna. Arm could probably not straighten more then about 90° angle.	EASHUM_2011

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
Grave 242	Unknown adult	Male	Radius	Right	Head, lateral	Fracture	Healed	Head of the radius has surface porosity and the articular surface has been extended laterally. Mobility of the joint was restricted due to the new bone formation of the humerus, radius and ulna. Arm could probably not straighten more then about 90° angle.	
ÞSK-A-004	26-35	Female	Rib	Left	3rd - 10th	Not specified	Healed	Possible healed rib fracture in a left rib, which rib is uncertain, probably 3-9	Heilsufarssaga Íslendinga I; The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-007	45+	Male	Rib	Left	3rd - 10th	fracture	Healed	healed fractures of three left 3rd - 10th ribs. Callus formation along all the fracture lines.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-007	45+	Male	Rib	Left	3rd - 10th	fracture	Healed	healed fractures of three left 3rd - 10th ribs. Callus formation along all the fracture lines.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
ÞSK-A-007	45+	Male	Rib	Left	3rd - 10th	fracture	Healed	healed fractures of three left 3rd - 10th ribs. Callus formation along all the fracture lines.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-008	17-25	Female	Coccyx	Not specified	Not specified	fracture	Healed	The coccyx has fused onto the sacrum. Most likely caused by a fracture/trauma	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-009	45+	Female	Ulna	Right	distal 1/3 of the shaft	Possible fracture	Healed	slight lateral warping of the distal 1/3 of the shaft, of about 15° compared to the left leg.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-009	45+	Female	Tibia	Left	distal shaft	Possible fracture	Healed	Latereal bowing of the distal half of the shaft, 15° compared to the right bone	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
ÞSK-A-012	36-45	Female	Metacarpal	Left	styloid process of the 3rd meta.	Fracture	Healed	Heald fracture of the styloid process of the 3rd metacarpal of the left hand. The process has broken completely off.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-016	36-45	Female	Tibia	Right	distal 1/3 of the shaft	Oblique fracture	Healing	Very severe fracture of the right tibia. There is an oblique fracture (running distally from the lateral to the medial side of the bone) of the distal 1/3 of the shaft. This individual only lived a few weeks/months after the fracture occurred.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-030	36-45	Male	Clavicle	Left	lateral part of the shaft	fracture	Healed	Severe posterior displacement of the lateral part of the bone, and a 58° malalignment. There is a thic ossified callus formation surrounds the fracture	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-033	45+	Male	Ulna	Left	distal 1/3 of the shaft	possible Greenstick f.	Healed	there is a malalignment of approximatly 25° laterally, of the distal 1/3 of the shaft. There is no clear fracture line, indicating that if this is a fracture it most likely occurred ata very young age.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
ÞSK-A-036	45+	Male	Fibula	Right	Running inferiorly from the posterior to superior border of the midshaft	Spiral fracture	Healed	There is a spiral fracture running inferiorly from the posterior to superior border of the midshaft of the right fibula. There is no malalignment or displacement of the fracture which is sealed by slight long standing ossified callus.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-036	45+	Male	Talus	Left	lateral border of the posterior calcaneal articular surface	fracture	No healing	not a result of the same event as the other fracture	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-041	26-35	Male	Talus	Right	postero-medial quadrant of the posteroal calcaneal articular surface	Fracture	Healed	a fragment has broken off and rehealed. There is a little displacement, and the bone surrounding the fracture line is compact.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-051	36-45	female	phalange	Unsided	upper middle phalanx	fracture	Healed	they are bowed to the palmar side of the bone at the distal 1/3 of the bone at an angle of a 33°. There is no clear fracture line or callus formation, well healed.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
ÞSK-A-051	36-45	female	phalange	Unsided	upper middle phalanx	fracture	Healed	they are bowed to the palmar side of the bone at the distal 1/3 of the bone at an angle of a 33°. There is no clear fracture line or callus formation, well healed.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-051	36-45	female	Femur	Left	neck	fracture	Healed	the neck of the left femur is abnormally short, with the head displaced slightly superiorly and laterally.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-051	36-45	female	phalange	Unsided	lower proximal	fracture	Healed	3mm thick ossified callous formation on the plantar side of the shaft, immediately superior to the head.	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
ÞSK-A-056	45+	Female	Thoracic vert. 8th	Center	Body	Compression fracture	Healed	Compression fracture of the 8th and 9th thoracic vertebrae. Fracture is long standing and have resulted in a slight kyphosis of the spine	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
ÞSK-A-056	45+	Female	Thoracic vert. 9th	Center	Body	Compression fracture	Healed	Compression fracture of the 8th and 9th thoracic vertebrae. Fracture is long standing and have resulted in a slight kyphosis of the spine	The Palaeopathology of Iceland: Preliminary report III. Skeljastaðir & kuml
VEY-A-003	36-45	Male	Clavicle	Right	Acromial end	Fracture	Healed	the right clavicle is 50mm shorter then the left one. Possible fracture at the acromial end, medial to the coniod tubercle. Probably occurd in early childhood, since no new bone formation was observed.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-004	36-45	Female	Calcaneus	Right	Proximal end	Complete fracture	Healed	Healed fracture on the proximal end of the calcaneus which has completely broken off but remodelled so the *facies articularis cuboidea* points more downwards than normal. This fracture has led to the desctruction of all ligaments in the right ankle and buildup of osteophytes.	The Palaeopathology of Iceland, Preliminary report 2003

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
VEY-A-012	36-45	Male	Thoracic Vertebrae	Body	8th	Compression fracture	Healed	Compression fracture of the thoracic vertebrae with scoliosis.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-012	36-45	Male	Thoracic Vertebrae	Body	9th	Compression fracture	Healed	Compression fracture of the thoracic vertebrae with scoliosis.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-012	36-45	Male	Thoracic Vertebrae	Body	10th	Compression fracture	Healed	Compression fracture of the thoracic vertebrae with scoliosis.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-014	36-45	Male	Thoracic Vertebrae	Body	7th	Compression fracture	Healed	Compression fracture of the thoracic vertebrae with scoliosis.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-014	36-45	Male	Thoracic Vertebrae	Body	8th	Compression fracture	Healed	Compression fracture of the thoracic vertebrae with scoliosis.	The Palaeopathology of Iceland, Preliminary report 2003

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
VEY-A-015	17-25	Male	Phalanx	Not sided	Proximal	Oblique	Healed	Fracture of an unsided upper proximal phalange, an oblique fracture from 7mm below the head to 6mm above the proximal articular surface. The fracture is long standing, well healed, and only very slightly displaced.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-016	45+	Female	Patella	Left	Medial border	Fracture	Healed	Fracture in the medial border of the left patella with non-union of the fragment and sclerotic bone formation along the fracture line. Possibly the area has necrosed.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-021b	45+	Male	Lumbar Vertebrae	Body	5th	Complete fracture	Healed	Complete fracture with non-union of the left superior process of the 5th lubar vertebrae. This is known as spondylolisis.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-021b	45+	Male	Patella	Left	Medial side	Complete fracture	Healed	Complete fragmentation with reunion of the fragment of the medial side of the left patella. There has been slight distal displacement of the fragment.	The Palaeopathology of Iceland, Preliminary report 2003

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
VEY-A-026	36-45	Male	Clavicle	Right	Sternal end	Fracture	Healed	Fracture across the sternal end of the right clavicle, across the line of the coracoid tubercle, with little new bone formation surrounding the fracture line. Probably from the same traumatic event which cause the other fracture.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-026	36-45	Male	Phalanx	Not sided	Proximal	Complete fracture	Healed	Complete fracture with reunion of the dorsal part of the proximal articular surface of an unsided upper proximal phalange. Probably from the same traumatic event which cause the other fracture.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-029	36-45	Male	Nasal bone	Right	Distal third	Fracture	Healed	fracture from the distal third of the right nasal bone, extending round to the distal right side corner of the left nasal bone. The fragment has been displaced slightly to the left with a small hole in the right bone (7 mm long) and a depression formed in the fragment of the right nasal bone. Probably from the same traumatic event as the other fractures.	The Palaeopathology of Iceland, Preliminary report 2003

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
VEY-A-029	36-45	Male	Rib	Right	Near the angle	Fracture	Healed	3rd -10th. It has a long standing compact bone formation along the fracture lines, and there has been a slight superior displacement of the fragments. Probably from the same traumatic event as the other fractures.	The Palaeopathology of Iceland, Preliminary report 2003
VEY-A-029	36-45	Male	Rib	Right	Near the angle	Fracture	Healed	3rd -10th. It has a long standing compact bone formation along the fracture lines, and there has been a slight superior displacement of the fragments. Probably from the same traumatic event as the other fractures.	The Palaeopathology of Iceland, Preliminary report 2003
RVK-A-001	26-35	Female	Patella	Right	Lateral facet	Healed	Healed	Possibly linked to the same event that caused the rib fractures.	Heilsufarssaga Íslendinga I; Heilsufarssaga Íslendinga III
RVK-A-001	26-35	Female	Rib	Right	3rd-10th rib	Healed	Not specified	Fractures along the inferior part of the angle. Two ribs. Possibly linked to the patella fracture.	Heilsufarssaga Íslendinga I; Heilsufarssaga Íslendinga III
RVK-A-001	26-35	Female	Rib	Right	3rd-10th rib	Healed	Not specified	Fractures along the inferior part of the angle. Two ribs. Possibly linked to the patella fracture.	Heilsufarssaga Íslendinga I; Heilsufarssaga Íslendinga III
RVK-A-002	36-45	Male	Phalange	Not specified	Middle, lower	Not specified	Healed	Possible well healed fracture of a single unsided lower middle phal.	Heilsufarssaga Íslendinga III

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
RVK-A-003	36-45	Male	Rib	Right	3rd-10th rib	Not specified	Not healed	The fracture is along the mid part of the shaft. Not healed and there are porous woven bone along the fracture line indicating that htis individual only survived a few weeks at the most after the trauma.	Heilsufarssaga Íslendinga III
RVK-A-006	36-45	Male	Tibia	Left	Center	Greenstick Fracture	Healed	Slight anterior and medial bowing of the centre of the shaft with no associated callus formation. Not possible to exlude other pathologies like rickets, but since it is isolated to one side means that it is likely from traumatic origins.	Heilsufarssaga Íslendinga III
RVK-C-001	26-35	Male	Mandible	Right	Mandibular head	Not specified	Healed	The fracture is along the meidal 1/3 of the head, and the re-healed fragment is slightly displaced inferiorly.	Heilsufarssaga Íslendinga III
RVK-C-003	36-45	Female	Talus	Left	Posterio-lateral quadrant of the posterior calcaneal articular surface	Not specified	Healed	Posterio-lateral quadrant of the posterior calcaneal articular surface has fractured off completely and the fragment re-healed onto the bone	Heilsufarssaga Íslendinga III

Grave number	Age Category	Estimated sex	Bone	Side	Position	Type	Healed or not healed	Personal notes	source
RVK-C-004	36-45	Male	Talus	Left	Posterior part of the calcaneal articular surface	Not specified	Not specified	The fracture is on the posterior part of the calcaneal articular surface, but the whole bone has been completely remodelled with severe degenerative changes which have obliterated any fracture lines. The ankle joint has secondary osteoarthritis as a result of this fracture and the osteochondritis dissecans discussed below is most likely associated with the same traumatic event.	Heilsufarssaga Íslendinga III