

# Osteobiography of Gröf A-21 from Keldudalur, Iceland

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## Abstract

Around 1000 A.D., the Icelandic government declared a conversion from Paganism to Christianity for all Icelandic citizens. Due to this sudden change and a lack of official churches at which to worship, many Icelanders built small, family Christian churches on their own land. Keldudalur, a farm in Northern Iceland, is now an archaeological site with the remains of such a church and cemetery. In 2002 and 2003, 52 Viking-Age individuals were discovered in the cemetery at Keldudalur. One of these individuals, Gröf A-21, possessed multiple lytic foci in numerous locations on the skeleton. The lesions vary in size from 2-10mm in diameter, and are concentrated on the ribs, scapulae, clavicles, os coxae, and vertebrae. Utilizing standard paleopathological methodologies of observation, description, and comparisons with the clinical literature, I undertook a differential diagnosis of the possible etiology of this pathology. Multiple myeloma, a disease which causes atypical blood cells to hinder the production of new blood cells in bone marrow, causes skeletal lesions that match the appearance and patterning found in the remains of Gröf A-21. However, there are other hematopoietic diseases that can leave similar skeletal lesions to multiple myeloma, such as prostatic carcinoma, breast carcinoma, leukemia, etc. When the visible lesions on Gröf A-21 were compared to the characteristics of the various hematopoietic diseases, multiple myeloma seems to be the most likely cause of this pathology. Radiographs would be necessary for a conclusive diagnosis, but the observational evidence suggests a differential diagnosis of multiple myeloma.

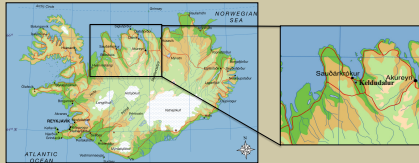


Fig. 1: Map of the Skagafjörður, Iceland

## Introduction

The Viking Age in Iceland was an important time for the Icelandic people, and Icelandic culture. Around 1000 A.D., the Icelandic government officially declared that Christianity was the country's new religion – though some Icelanders had switched from Paganism to Christianity already, the whole country underwent a religious transformation. However, due to this sudden decision by the Icelandic government, official Christian churches had yet to be erected. In order to worship and properly bury their dead according to the new Christian laws, Icelanders began building small churches on their family land (Zoëga 2007). After several generations, when large Christian chapels and churches were finally built, the Icelanders would tear down their private churches and, in some cases, would move their dead family members to new, consecrated ground.

This switch from Paganism to Christianity has generated a great deal of interest among archaeologists, as well as the Icelandic government. Surveys of almost all Icelandic farmsteads have been or are in the process of being done in order to ascertain the presence of structures from the Viking Age. In Northern Iceland, a large number of small-scale archaeological excavations have been performed in order to unearth these churches and the cemeteries that tend to be present with them (Zoëga 2007).

Keldudalur (Fig. 1), a site in Northern Iceland, was originally excavated to become the foundation for a tourist building, but the excavation was halted once human remains were discovered. A salvage dig was undertaken, and over the course of two years, 52 graves were discovered within the churchyard (Zoëga 2007). One of those graves, Gröf A-21, contained human skeletal remains with a skeletal pathology that is the focus of this research. Utilizing standard methods from Buikstra and Ubelaker (1994), Zoëga estimates that the remains are those of a male who is 50+ years old at the time of death.

## Methods

In the examination of the pathology on the human remains of Gröf A-21, I utilized several techniques that aided me in my differential diagnosis. Understanding the bony response to stressors such as disease or trauma is especially important, as there are only two ways that bone can react. The body can either produce new bone (proliferation), or remove bone (resorption) in response to various stressors (Ortner 2003). One of the primary methods used for paleopathological research, gross description, requires careful documentation of skeletal abnormalities in order to identify the disease process. Following established criteria (Buikstra and Ubelaker, 1994; Ortner, 2003; Steinbock, 1976), for detailed gross description, a researcher must: "(1) use unequivocal terminology, (2) an exact description of locations and distribution of abnormal bone, (3) a detailed and descriptive summary of skeletal morphology, and (4) a comparison to clinical descriptions of diseases with skeletal involvement" (Buikstra and Ubelaker, 1994:108). Following this protocol, I examined and photographed the entire skeleton of Gröf A-21 in order to collect as much information about the lesions as possible for a differential diagnosis.

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Figure 2: Left Clavicle – lesions on acromial end.  
 Figure 3: Right Scapula – view of lesions on superior surface.  
 Figure 4: L1 – view of lesions on superior surface of centrum.  
 Figure 5: Right Rib 6 – lesions on lateral surface.  
 Figure 6: Right Rib 5 – lesions on inferior surface.  
 Figure 7: Os Coxae – view of lesions on medial surfaces of the Ischia  
 Figure 8: Right Ischium – close-up view of lesions on medial surface

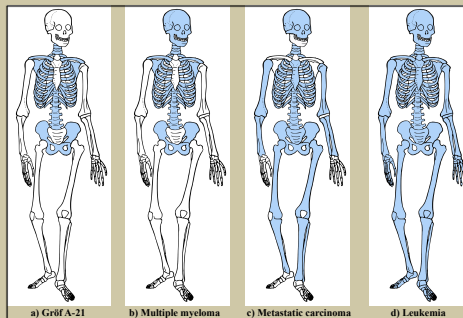


Fig. 9a-d (PD-US): Illustration of the patterning of lesions associated with three hematopoietic diseases from the clinical literature (shaded blue, after Marks & Hamilton 2007:230). The lesions present through gross description on Gröf A-21 are also displayed for differential diagnostic purposes. Note the only differences between Multiple myeloma and Gröf A-21 are the cranium and mandible – these bones will be radiographed to examine the endocranial surfaces.

## Results

Figures 2-8 illustrate both the lesion appearance and distribution on various elements. The lesions present on the remains of Gröf A-21 are osteolytic (resorptive) in nature, with a lack of any osteoblastic (new bone/proliferative) activity. The lesions are round, with sharp and extremely localized edges, indicating a lack of healing at the lesion site. Not only are the lesions similar in type, but the size is consistently small throughout the skeleton (4-10mm in diameter). The patterning of the lesions present on all of the bones can be found in Figure 9. The distribution of the lesions is focused mainly in the area of the torso, and they are quite symmetrical – in the event of paired bones, both sides present with lesions (For example, see Fig. 7).

After compiling my observations and photographs relating to the remains, I undertook a differential diagnosis by comparing my observations to the clinical data and other case studies with similar skeletal lesions. Table 1 presents the most likely diseases that cause similar lesions to the ones found on Gröf A-21. This table includes multiple myeloma, leukemia, and two versions of metastatic carcinoma – breast and prostatic carcinomas. There are a number of characteristics incorporated into the table that would best describe the skeletal pathology that each disease could present with, such as age of onset, sex of normally affected individuals, affected areas of the skeleton, appearance of lesions on x-rays, and distribution, type and size of lesions.

TABLE 1: Distinguishing characteristics of bone pathologies resulting from various hematopoietic diseases.

(Data derived from Ortner, 2003; Aufderheide & Rodriguez-Martin, 1998; Marks & Hamilton, 2007)

	Multiple myeloma	Breast carcinoma	Prostatic carcinoma	Leukemia
<b>Common Age of Onset</b>	Between 50 and 70 years of age	45+ years of age	45+ years of age	Juvenile years +
<b>Bones affected</b>	Skull, mandible, scapulae, clavicles, vertebrae, ribs, os coxae	Skull, sternum, vertebrae, os coxae, ribs, major long bones	Skull, sternum, vertebrae, os coxae, ribs, major long bones	Entire skeleton, especially metaphyses
<b>Distribution of Lesions</b>	Widely distributed, symmetrical	Concentrated in certain areas, asymmetrical	Concentrated in certain areas, asymmetrical	Cortical surface of metaphyses
<b>Type of Lesions</b>	Osteolytic lesions, sharp/localized edges	Osteoblastic lesions	Mix of osteolytic/osteoblastic lesions	Osteolytic and sclerotic lesions, general thinning/loss of bone
<b>Size of Lesions</b>	Consistently small and round, 0.5-2 cm in diameter	Variable in size and shape	Variable in size and shape	Variable in size and shape
<b>Sex of Individuals</b>	Mostly males	Males	Mostly females	Males and females
<b>Radiographic Appearance</b>	Osteolytic lesions, "moth eaten" appearance	Multiple osteoblastic lesions, new bone	Multiple osteolytic lesions, new bone	Lines on the metaphyseal side of growth plates

## Discussion and Conclusions

After examining the data compiled in Table 1, I have come to the conclusion that Gröf A-21 suffered from multiple myeloma based on the following evidence:

- Gröf A-21 was estimated to be 50+ years old at the time of death. All three hematopoietic diseases described in Table 1 could occur in an individual from this age range, although leukemia is less likely, given its tendency to occur in younger individuals (Ortner 2003).
- Zoëga estimated the sex of Gröf A-21 to be male. While this doesn't eliminate any of the hematopoietic diseases described in Table 1, breast carcinoma is more likely to occur in females than males and multiple myeloma is more common in males than females (Ortner 2003).
- The lesions in Gröf A-21 are all osteolytic in nature. Osteolytic lesions with an absence of osteoblastic activity are almost always a sign of multiple myeloma. Osteoblastic bone formation, which would normally appear with metastatic carcinomas, is not present on Gröf A-21, suggesting multiple myeloma as opposed to metastatic carcinomas such as breast and prostate cancers (Ortner 2003).
- The scapulae, clavicles, vertebrae, ribs, and os coxae are covered in osteolytic lesions that are consistently small (the biggest is 10mm in diameter), with sharp edges. This skeletal patterning of lesions is most consistent with those of multiple myeloma (Fig. 9). Prostatic carcinomas have a similar distribution of lesions, but the size and shape of the lesions is more variable (Ortner 2003).

The remains of Gröf A-21 are well preserved, and the distribution, type, size, and shape of all the lesions present indicate multiple myeloma. While much of the observational evidence from the gross description of the pathology found in the remains Gröf A-21 is highly suggestive of multiple myeloma, one must remain cautious when developing a differential diagnosis with archaeological material. First, the skull is typically involved in the diseases processes associated with multiple myeloma. Unfortunately, there are no lesions visible ectocranially on the cranium or mandible. Second, I was unable to obtain radiographs on Gröf A-21 during the short time I was in Iceland during the summer. Since it is necessary for any differential diagnosis to include evidence from radiographs, a final diagnosis of multiple myeloma is tentative but highly suggestive.

## Acknowledgements

- The Summer Science Program, sponsored by Kenyon College.
- My advisor, Kimmarie Murphy, Ph.D., Professor of Anthropology, Kenyon College.
- Guðný Zoëga, M.S., Osteoarchaeologist, Head of the Department of Archaeology at the Skagafjörður Folk Museum, Iceland.
- Skagafjörður Archaeological Settlement Survey (SASS)
  - Douglas Bolender, Ph.D., Field Museum and Northwestern University.
  - John Steinberg, Ph.D., Fiske Center for Archaeological Research, Dept. of Anthropology, UMass Boston.