

Introduction

Finding traces of pregnancy and childbirth on the female pelvic bones has concerned anthropologists for a long time. Several attempts to determine indicators as proofs of parity have worked with archaeological material and samples of known parity. The preauricular sulcus, the interosseous groove and the dorsal pubic surface are most frequently investigated (e.g. Putschar 1931, Stewart 1970, Ullrich 1975, Houghton 1975, Bergfelder & Herrmann 1978, Holt 1978, Kelley 1979, Suchey et al. 1979, Breiting 1990). None of these indicators alone, however, can determine with absolute certainty whether or not a woman has given birth on an individual level (Cox 2006, Ubelaker & De la Paz 2012). The project 'The social status of motherhood in Bronze Age Europe' investigates motherhood in prehistory (<http://www.oeaw.ac.at/mutterschaft.html>), from both an anthropological and archaeological point of view. This pilot study focuses on recording several suggested 'parity features' on the pelvis of juvenile and adult skeletons from the Bronze Age site of Unterhauzentental (Lower Austria, Únětice Culture, c. 2000-1600 BC; Lauer 1991, 1995). These results are contextualised with archaeological data, including placement of the bodies, grave construction, the symbolic dimension of co-buried objects, and status differences expressed through funerary treatment, as well as in the quality and quantity of grave goods. Other recorded skeletal features concern the general health of individuals and evidence for interpersonal violence. The site of Unterhauzentental includes 46 individuals from the cemetery and 8 individuals from the contemporary settlement. Male, female, juvenile and infant burials were found, including one double and two triple burials. Many graves were found disturbed and objects had been removed; however, differences in depth, size and furnishing of the graves were noted. The spectrum of grave goods is simple, as expected for the early Bronze Age, but there is some age and gender-specific variation. Relationships between family members appear to be expressed in the way bodies were buried together in double and triple graves. Skeletal remains of newborns and small children are frequently included in women's graves. Grave V95, for example, included a 35-45 year old woman buried with two children; the 3-4 year-old was placed in front of her face, the 5-year old in the space behind her legs. Comparing results from Unterhauzentental to statistically significant series of female individuals from different Bronze Age sites, and later from other cultural groups, will deliver results on a population level.

Material and Methods

The first skeletal collection examined as part of this research framework from the site of Unterhauzentental is housed at the Natural History Museum in Vienna. Both male and female skeletons (n=31: 28 adults, 3 sexed juveniles, 18 females, 13 males) with ages ranging from 16 to 55 years (mean age females 36.7 years, males 37.3 years) are analysed for comparison. The sample was further divided into age and body height groups for calculations (two age groups: 14-35 and 36-55 years, two body height groups: <160cm, including only one male, >160cm). A specially developed scoring sheet was used to record selected 'parity features' on the pelvic bones and pathological changes (selected unspecific indicators of stress, inflammatory changes, endocranial changes, trauma, indicators of nutritional deficiencies). Individuals with significant pathologies (e.g. skull fractures) are discussed by Spannagl-Steiner et al. at this conference. The selected pelvic features include the **preauricular sulcus** (examination of the shape of the sulcus and inferior pelvis after Bruzek 2002, characteristics for the preauricular sulcus following Steckel et al., 2006), the **extended pubic tubercle** (including measurements, adapted from Maas 2012, Snodgrass & Galloway 2003), **exostoses at the margin of the auricular surface** (exostoses at the margin of the sacroiliac joint present/not present), lesions at the **dorsal pubic surface** ('dorsal pubic pitting', adapted from Stewart 1970) and exostoses at the **ventral pubic surface** (adapted from Ullrich 1975, Kelley 1979). Further, fractures at the os pubis, ischium and sacrum and muscle markings of the gluteal muscles (*gluteus maximus/medius/minimus*) are recorded (lesions/ridges/exostoses present/not present). The length, width and depth of the **preauricular sulcus** (adapted from Decrausaz 2012, depth measure at the deepest point using a dental probe) and the length of the femur are measured. Combining a scoring of these markers with results of individual tooth cementum annulation analysis (TCA, in cooperation with F. Kanz, Dept. of Forensic Medicine Vienna) can provide insights into women's reproductive status. The genetic relationship of co-buried individuals will be tested by DNA analysis in cooperation with W. Parson, Institute of Legal Medicine Innsbruck, Austria.

References

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Results

First crosstabs calculations in SPSS 23 revealed some interesting results. Concerning pelvic markers and sex, the preauricular sulcus showed a significant association in the females on both sides (p=.017 at the right side and .004 at the left side, see tables 1a & b). Further, significant results were found on the left side in the females for the extended pubic tubercle (p=.038, tables 2a & b). The systematic analysis of the exostoses at the margin of the auricular surface also revealed a significant result on the left side in the females (p=.000, tables 3a & b). Calculations with age groups did not reveal significant connections. Interestingly, however, there is a significant relationship between the recorded features and body height: in the group of individuals with a body height between 145 and 160 cm (including only one male), 6 females (42.9% of total, p=.049) showed a significant result for the preauricular sulcus on the right side. A significant result was also obtained in the body height group <160 cm for the extended pubic tubercle on the right side (4 females, p=.035). A distinct ridge at the pectineal line of the pubis was found in two females, in both cases in combination with the presence of an extended tuberculum pubis (Fig. 1, 3D scan of a female pelvic bone V128). A distinct sexual dimorphism characterises this group in terms of body height: the mean estimation for the females is about 159 cm, and for the males 168 cm.

The osteo-biography of the young woman in grave 122

The youngest female individual (V122B) showing a positive association at most of the pelvic parity features under investigation is aged 17-20 years. This young woman was found in a triple burial (Fig. 2) together with a man aged between 35 and 40 years (TCA 47 ± 5y) and cranial fragments of a neonatal to six months-old child. Both adults were placed in crouched positions on their right sides, the woman in front of the man. Unfortunately, the grave had been disturbed after the decomposition of the bodies. A large set of pottery, some remaining fragments of bronze jewellery, and green stains left on the human bones by grave goods that were removed post-burial indicate a secure social standing of the individuals within the community. Tooth cementum analysis confirmed the age assessment of the young woman (19 ± 2y, Fig. 3), and traces of life-history parameters such as pregnancies and traumata (Kagerer & Grupe 2001) are currently under investigation. According to the morphological pelvic markers, the first individual results show that this young woman has a distinct preauricular sulcus, extended pubic tubercle and exostoses at the margin of the auricular surface (all grades 2). She further displays a noticeable exostosis below the right preauricular sulcus.

DNA analysis will clarify the genetic relationship of the three individuals. If the adults, staged as a couple in the grave, were indeed sexual partners, the age gap is significant. The young age of the mother appears in line with other Bronze Age findings (Rebay-Salisbury in press).

table 1a

preauricular sulcus left side (p.s.)	preauricular sulcus is smooth	a small, weakly developed p.s. is clearly present	p.s. is moderately developed	a large, well defined sulcus is present
male	7	1	0	0
% of Total	33.3%	4.8%	0.0%	0.0%
female	1	8	3	1
% of Total	4.8%	38.1%	14.3%	4.8%

table 1b

Chi-Square Tests			
preauricular sulcus left side (p.s.)	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.520*	3	.004

table 2a

extended tuberculum pubicum left side	Surface of Tub. pub. is smooth	a small extend. Tub. pub. is present (1-3mm)	Total
male	3	0	3
% of Total	30,0%	0,0%	30,0%
female	2	5	7
% of Total	20,0%	50,0%	70,0%

table 2b

Chi-Square Tests			
extended tuberculum pubicum left side	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.286*	1	.038

table 3a

exostoses sacroiliac joint left side	no exostoses present	exostoses present	Total
male	5	0	5
% of Total	31,3%	0,0%	31,3%
female	1	10	11
% of Total	6,3%	62,5%	68,8%

table 3b

Chi-Square Tests			
exostoses sacroiliac joint left side	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.121*	1	.000

Discussion

The appearance of individual pelvic features used to assess woman's parity status cannot be exclusively traced back to pregnancy and birth events, but also relate to age, biomechanics or pelvic flexibility (Suchey et al. 1979, Andersen 1986, Cox 2006, Mays 2015, Maas & Friedling 2016). For this study, several features most likely relating to parity status were selected to find a pattern, as evidence for distinct changes in more than one of the features increases the reliability of parity assessment (Kelley 1979). The cemetery of Unterhauzentental provides skeletal material of women that the archaeological context suggests were indeed mothers. The most reliable feature appears to be the preauricular groove. In this Bronze Age series from Unterhauzentental, moderately developed to well defined **preauricular sulci** were found to occur only in females, symmetrically in most cases. A statistically significant association between the presence of a distinct preauricular sulcus and parity status has recently been verified in a radiographic study (not found in males, McArthur et al. 2016). Further, the high presence of the **extended tuberculum pubis** on pelvis of females was found to be significant in the Unterhauzentental skeletons. Cox (1989, 2006) found a statistically significant relationship between parity status and an extended tubercle, and even between the extension and the number of births in the Spitalfields sample with known obstetric histories. The latter was also asserted by Bergfelder & Herrmann (1978) in dissected individuals with obstetric histories. The significant results according to the marginal **osteophytes at the sacroiliac joint** are also of interest: Faglia et al. (1998) showed in a CT study that exostoses occur at this joint in females with a higher frequency only in multipares.

The young woman from grave V122B displays three of the five main pelvic features probably related to childbirth (**well defined preauricular sulcus, extended pubic tubercle, osteophytes at the sacroiliac joint**), and an exostosis below the sulcus. This may indicate birth(s) at a young age, for Shibata et al. (2002) presumed that the 'birth of the first child, rather than subsequent births have the greatest effect on the sacroiliac joint' including osteophyte growth at its margin.

Outlook

The ability to reproduce is implicitly and explicitly assumed to contribute to women's social status, and may also be expressed in the funerary practice. This pilot study, funded by the Austrian Research Foundation FWF [Projekt P 26820], aims to develop a methodology to systematically investigate the relationship between women's life histories and their position in Bronze Age societies, as inferred through archaeological observations. Combining the latest developments in archaeological science, including paleopathology, TCA and aDNA analyses, will help us to gain new insights into motherhood in prehistory. The ERC-funded project 'The value of mothers to society: responses to motherhood and child rearing practices in prehistoric Europe' led by Katharina Rebay-Salisbury [Starting Grant 2015, Project No. 676828] will expand the archaeological-anthropological research framework chronologically and thematically.

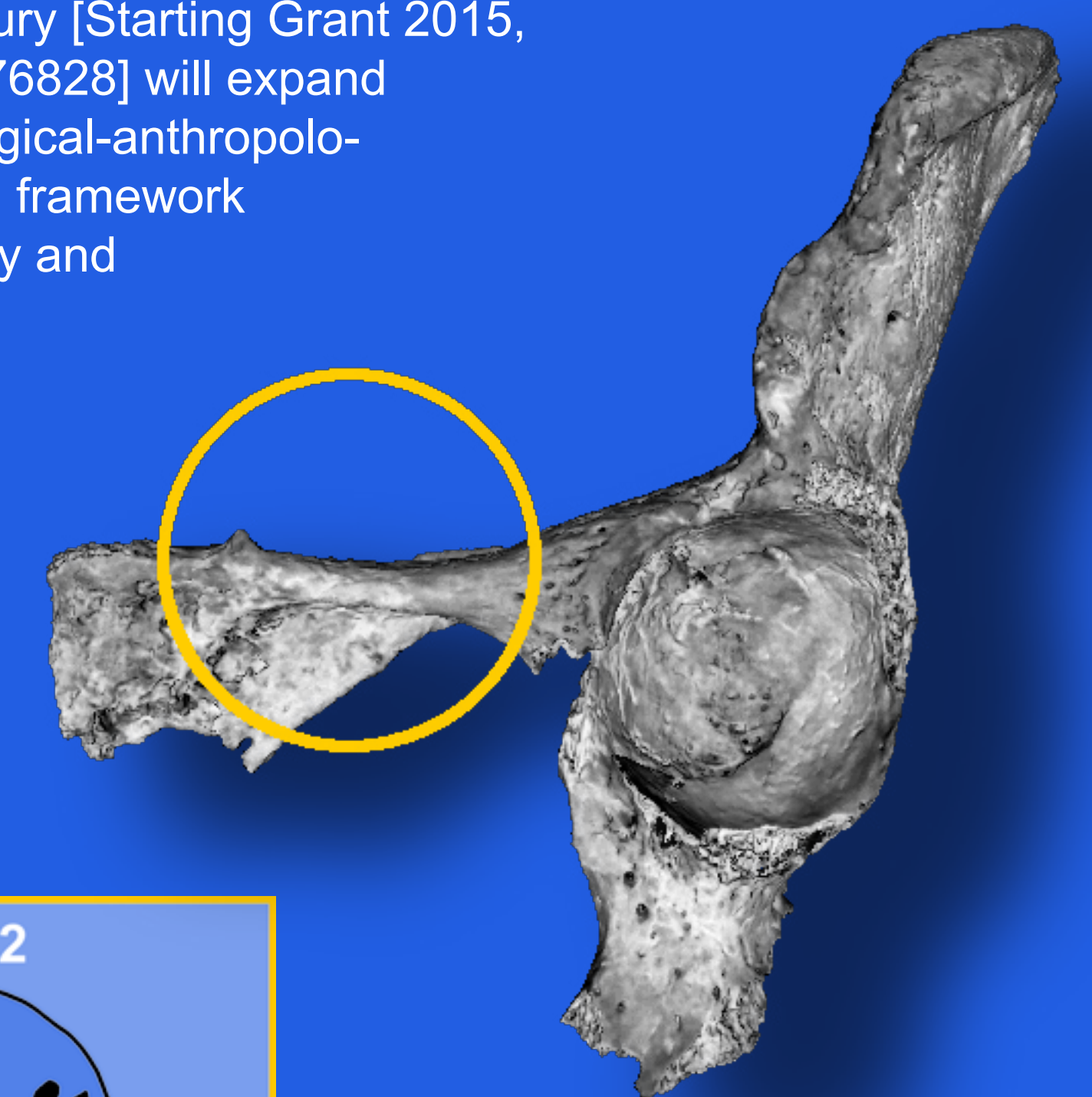


Fig. 1

3D scan of a female pelvic bone (V128) displaying an extended tuberculum pubis and a distinct ridge at the Pecten ossis pubis

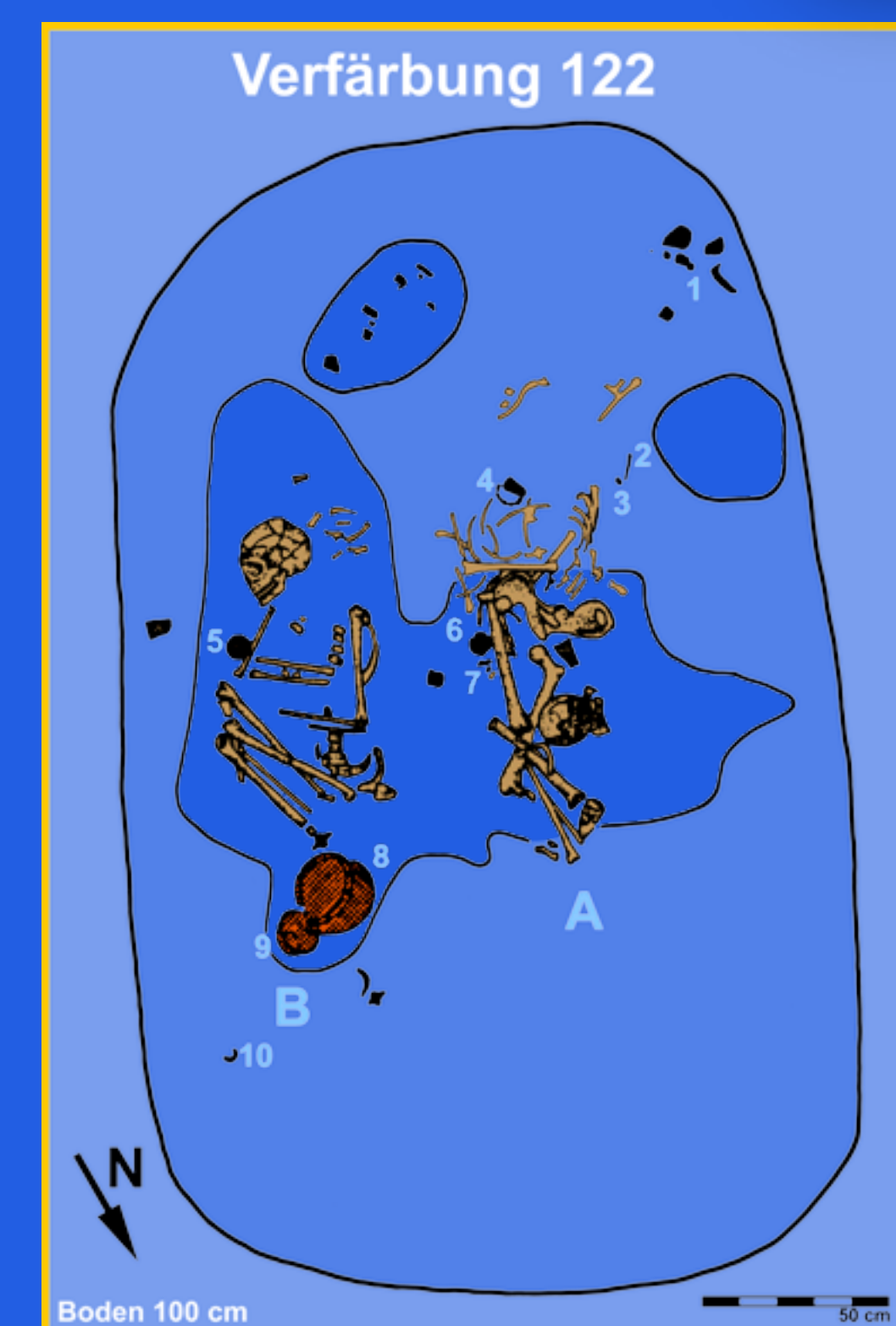


Fig. 2

Unterhauzentental V122, a 17-20 year old woman found in a triple burial with the remains of a male skeleton and the remains of a neonate.

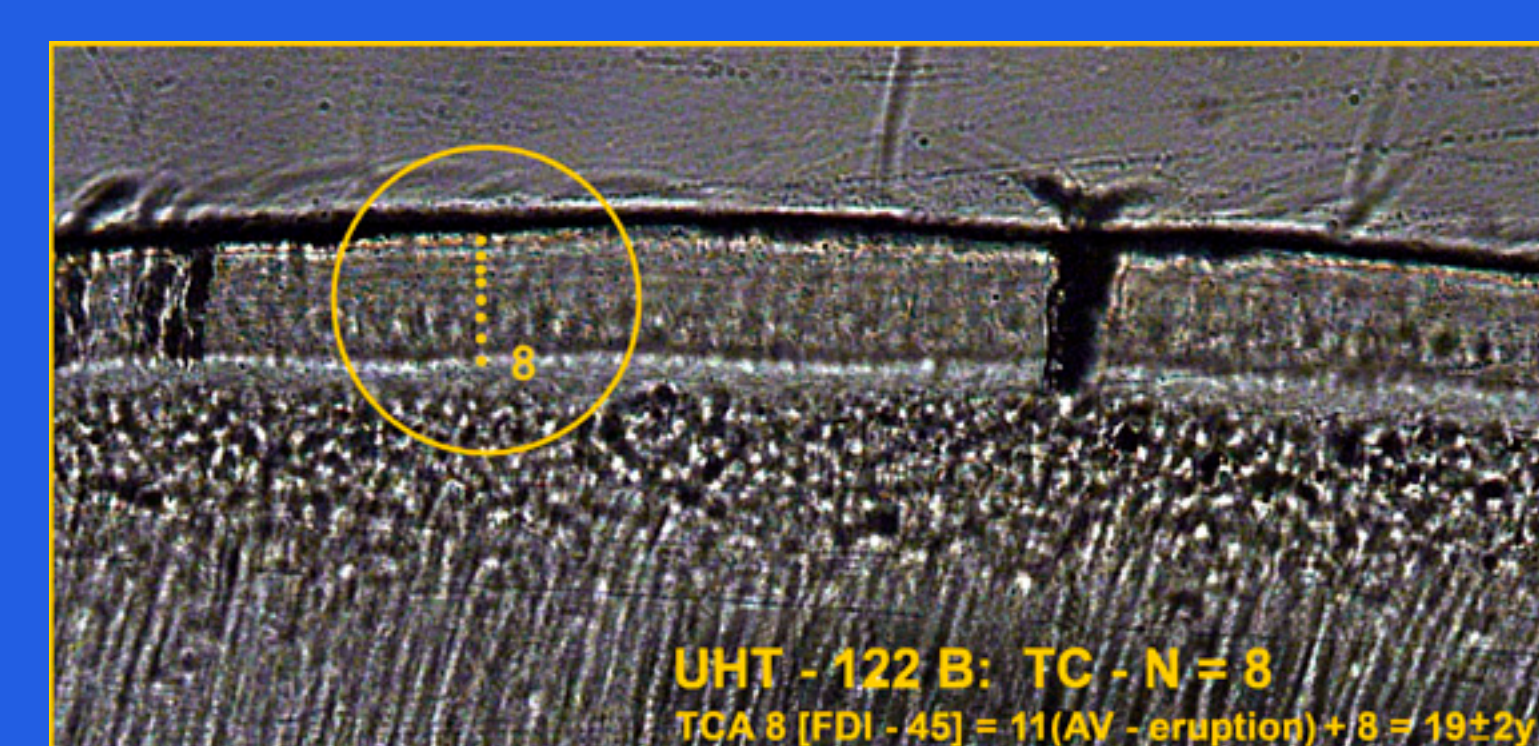


Fig. 3

Age confirmation of the young woman in grave 122 B using TCA analysis (F. Kanz).

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