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Articolo

Biological profile and 2D/3D morphometric analysis of pre-protohistoric human skeletal remains from Eastern Alps

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Key words

- physical anthropology
- biological profile
- geometric morphometrics
- Eastern Alps

Parole chiave

- antropologia fisica
- profilo biologico
- morfometria geometrica
- Alpi Orientali

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Summary

The research proposes a review of pre-protohistoric human groups from Eastern Alps through qualitative and quantitative analysis of osteological finds. The sample consists of human skeletal remains from several archaeological sites of the Trentino-Alto Adige and covers a broad chronological period between the Upper Paleolithic and Early Bronze Age. The finds are part of the anthropological collection preserved at the MUSE – Museum of Sciences (Trento). Comparisons are represented by european specimens selected from the Howells' craniometric data set (1995). Through comparative analysis and innovative digital techniques for data processing (laser scanning, 2D / 3D landmark based geometric morphometrics, thin-plate spline, multivariate statistical analysis), we carried out an assessment of the biological profile and morphometric features by examining shape and size variation in the cranial district. Methods adopted, based on the quantification of geometric differences, allowed to estimate the degree of morphological affinity, biological relationships, paleopathology and skeletal features of people who populated the Eastern Alps, shedding new light on the origin of hunters and gatherers, neolithic transition and anatomical features.

Riassunto

La ricerca propone un riesame dei gruppi umani pre-protostorici delle Alpi Orientali tramite indagini qualitative e quantitative dei reperti osteologici. Il campione di studio è costituito da resti scheletrici umani provenienti da diversi siti archeologici del Trentino-Alto Adige e copre un ampio arco cronologico compreso tra Paleolitico superiore e età del Bronzo Antico. I reperti fanno parte della collezione antropologica conservata presso il MUSE - Museo delle Scienze di Trento. I confronti sono rappresentati da esemplari europei selezionati all'interno del data set osteometrico di Howells (1995). Mediante analisi comparative e innovative tecniche digitali per l'elaborazione dei dati (*laser scanning, landmark based geometric morphometrics 2D/3D, thin-plate spline*, analisi statistica multivariata), è stata svolta una valutazione del profilo biologico e dei caratteri morfometrici con un maggiore approfondimento per ciò che concerne le modificazioni nella forma e nelle dimensioni del distretto cranico. I metodi adottati, basati sulla quantificazione delle differenze geometriche, hanno permesso di stimare il grado di affinità morfologica, relazioni biologiche, paleopatologie e caratteristiche scheletriche degli individui che popolarono le Alpi Orientali, gettando nuova luce sulle origini dei gruppi di cacciatori e raccoglitori paleo-mesolitici, sulla transizione neolitica e sulle variabili anatomiche tra Paleolitico superiore e età del Bronzo.

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1. Introduction

The paper assesses the biological profile and the degree of morphological similarities of pre-protohistoric human groups from Eastern Alps. Human skeletal remains, analysed during the study, come from the archaeological sites of Riparo Dalmeri (Tn), Vatte di Zambana (Tn), La Vela (Tn) and Romagnano-Loc III (Tn).

Previous studies have focused on the age estimation at death and sex diagnosis with a deeper examination of dental microwears (Coppa *et al.*, 1997-99; Villa & Giacobini, 2006). In many cases, the focus was on the osteometric analysis of neo-eneolithic populations (Corrain et al., 1976), instead Alciati *et al.* (1990) conducted a preliminary examination of human variability, estimated on a national scale, according to 30 variants described by Berry & Berry (1967). These studies, although relevant from the scientific point of view, require further analysis in light of recent discoveries and the application of updated methods in support of the traditional ones in order to get a better understanding of the Eastern Alps population.

My research is focused on the following aims:

1. to identify distinctive features, injuries and paleopathology of each individual;
2. to recognise associations between different cranial morphologies;
3. to test hypothesis about paleo-mesolithic hunter-gatherers origins and quantify the degree of similarity of human groups between Neolithic and Bronze Age. Thanks to the integration between innovative virtual reality techniques, capable of developing into a digital space various aspects of the anatomy, and methods of multivariate statistical analysis, it was possible to interpret processes of biological variability. The applications of two-dimensional and three-dimensional geometric morphometrics allowed to describe in a repeatable and objective manner, through non-invasive investigations, changes in shape and size of the skeletal structure at regional scale.

Regarding the archaeological context, Riparo Dalmeri is located in Grigno (Tn) at 1240 m. The archaeological site is dated to the end of the Upper Palaeolithic (11,260 BP). It was a seasonal camp for hunting (Dalmeri *et al.*, 1991). Of particular value is the discovery of seven teeth, one of which in a ritual pit, during the 1995 and 2003-2004 excavation campaigns. Vatte di Zambana was excavated in 1968. The site is located along the right side of the Adige Valley. At the level of the cut 10 it was found a burial covered with twenty stones. The Sauveterrian stone industries indicate an anthropic frequentation during the Mesolithic. The excavations at La Vela, between 1960 and 2006, highlighted 15 burials attributable to the Square Mouth Vases Culture of the Middle Neolithic. The individuals were inhumed in stone case or stone fence on the left side, in the retracted position with the head facing north (Pedrotti *et al.*, 1977). In 1970 at Romagnano-Loc III came to light burials largely attributable to children deposed inside a tronco-conical vase (Capitanio, 1973; Perini, 1975). The necropolis dates back to the Early Bronze Age, at the stage of Polada-A Culture.

2. Materials and methods

The sample is composed of six deciduous teeth, five incisors and one first molar (RDQ48M/14, RDQ47/14a, RDQ44M/22, RDQ42M/26c, RDQ45F/67, RDQ47F/72), found at Riparo Dalmeri (Villa & Giacobini, 2006); an almost complete skeleton (VZa) that can be reported to a Mesolithic primary deposition found at Vatte di Zambana (Corrain *et al.*, 1976); fragmentary human skeletal remains of the Middle Neolithic belonging to two individuals, Vel.R («*Ratratto*», Corrain *et al.*, 1996) and Vel.02, from the site of La Vela; fragmentary human skeletal remains of the Early Bronze Age from the burial n. 13 of Romagnano-Loc III (Ro.13).

The research was divided into three phases. The first consisted in the use of macro and microscopic methods for the correct assessment of the biological profile. The second related to digital analysis of bone surfaces. In the third phase it was conducted the morphometric study of adults. In this context, it became necessary the extension of the sample with data from literature in order to compare multiple configurations (Tab. 1), for a total of 55 individuals (18F-33M-3N[1]-1ND). Comparisons were represented by european specimens from the W.W. Howells archive (1995)[2]. The statistical analysis was aimed at defining and interpreting the results. On Vel.02 and Ro.13 we carried out just a brief description because they were attached to the sediment for exhibition reasons.

The biological profile has been rebuilt employing combined metric and morphological methods. With regard to age estimation and sex diagnosis of adults: Meindl & Lovejoy (1985); Brothwell (1981); Smith (1985); Acsadi & Nemeskeri (1970); Buikstra & Ubelaker (1994); Loth & Henneberg (1996); Cattaneo & Grandi (2004). About the stature determination, Olivier *et al.* (1978), Trotter & Glaser (1952). For juvanile skeletal remains we used macroscopic description criteria of Scott & Turner (1997). The profile of teeth was vectorised and the age calculated according to: Ubelaker (1989); Molnar (1972); Stloukal & Hanakova (1978); Schaefer *et al.* (2009). The biological profile is completed with the evaluation of pathological markers and description of injuries according to Fornaciari & Giuffra (2009), Ortner *et al.* (2003), Cattaneo & Grandi (2004).

The microscopic analysis has been conducted with Leica M165C with magnifications from 7.3 to 120 X. To better define the range of variation, morphology and measurements were taken using 2D / 3D geometric morphometrics (Bookstein, 1991). The main focus was on the neurocranium as more under genetic control than the post-cranial skeleton, which suffers most from environmental influences. According to the treaty of Martin & Saller (1957) we identified 15 landmarks in frontal view and 16 in lateral view (Fig. 1 b). These then were typed on two-dimensional images and three-dimensional models with the toolbox TPS of the Stony Brook University[3] (Adams *et al.*, 2002) and the software LANDMARK of the University of Kaiserslautern, Institute for Data Analysis and Visualization (IDAV)[4]. 2D models have been standardized on TpsDig, while 3D scans were performed with Laser Scanner Optoma X401. Surfaces were merged and finalized with MeshLab (3D Image Processing; Fig. 1). The curvature map was carried out only on VZa and Vel.R, in order to identify convexities and concavities (Meyer *et al.*, 1999).

Concerning the multivariate statistical analysis we used MorphoJ (University of Manchester; Klingenberg, 2011)[5], and PAST (University of Oslo; Hammer, 2001)[6]: Procrustes superimposition (Rohlf & Slice, 1990); principal component analysis (PCA), on 15 two-dimensional landmarks in lateral view, to obtain a linear projection of the original variables in a new Cartesian system in which variables were arranged in descending order of variance; geometry of main components using thin-plate spline; degree of similarity and quantification of biological distance by means of matrices (matching-type); standardization with Euclidean matrix and UPGMA algorithm (Unweighted Pair-Group Method Using Arithmetic Averages; Sneath & Sokal, 1973).

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1 N= average necropolis

2 Howells W.W., 1995. Who's Who in Skulls. Ethnic Identification of Crania from Measurements. Papers of the Peabody Museum of Archaeology and Ethnology, vol. 82, pp. 108. Cambridge, Mass.: Peabody Museum. http://web.utk.edu/~auerbach/HOWL.htm.

3 http://life.bio.sunysb.edu/morph/

4 Evolutionary Morphing: http://graphics.idav.ucdavis.edu/research/EvoMorph.

5 MorphoJ: http://www.flywings.org.uk/papers_page.htm

6 Hammer Ø., Harper D.A.T., Ryan P.D., 2001. http://palaeo-electronica.org/2001_1/past/issue1_01.htm.

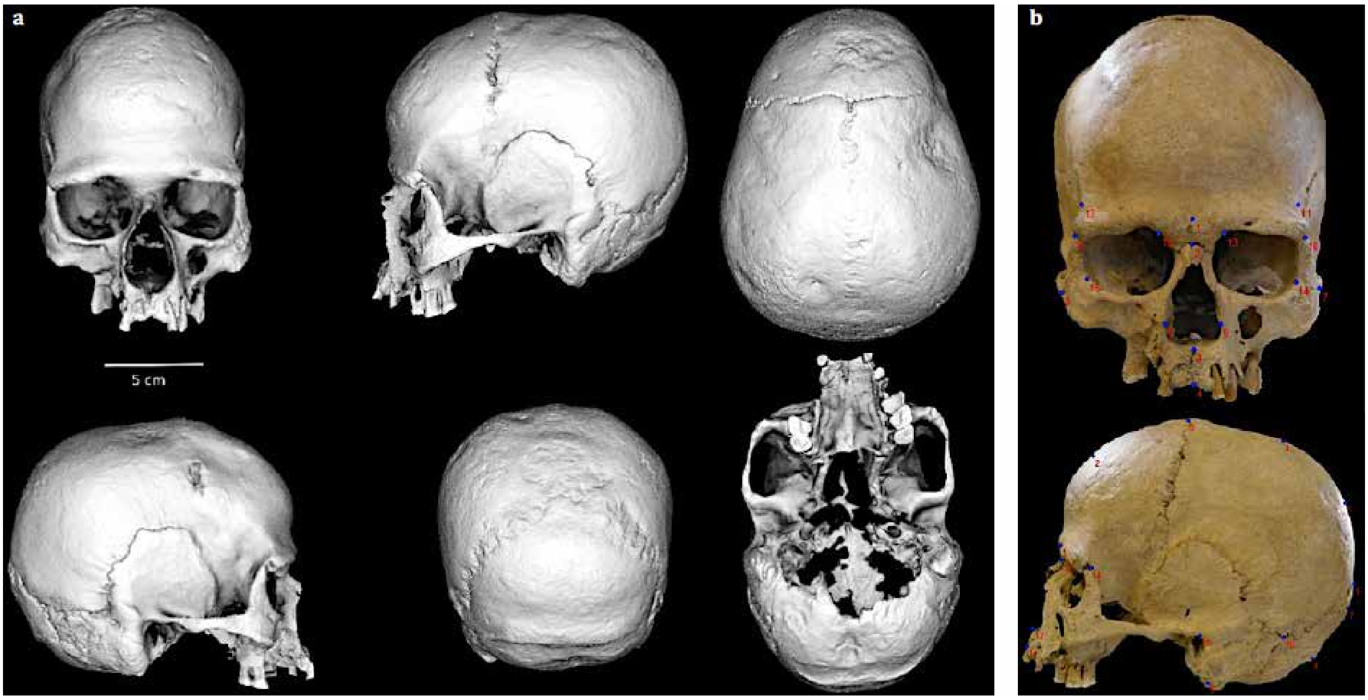


Fig. 1 - *a) 3D model of VZa; b) landmarks in front view and lateral view for 2D / TPS. / a) modello 3D VZa; b) landmarks in norma frontale e laterale per 2D / TPS.*

3. Results

3.1. Macro-microscopic analysis

RDQ48M/14 and RDQ45F/67 (Fig. 2 a-c; Fig. 3 c-d) are upper right first incisors (i^1), whereas RDQ47/14a, RDQ44M/22, RDQ42M/26c (Figs. 2, 2 l-q, 3 a-b) upper right second incisors (i^2). RDQ47F/72 (Fig. 3 g) is a left lower first molar (m_1). All of them are primary teeth. The roots have irregular margins that are interrupted at about 2-3 mm from the collar. The occlusal surface of RDQ48M/14, at the microscopic level, is affected by numerous orthogonal striae with variable depth. RDQ47/14a is distinguished by the presence, on the occlusal surface, of a circular cavity in rounded edges linked to the pulp chamber (Fig. 2 f-i). The hole has a diameter of 1,2 mm. RDQ44M/22, buccally, shows a square-shaped fracture in net margins (2,2x1,9 mm; Fig. 2 n). At the level of the collar an accumulation of tartar (Fig. 2 p) and, mesially, two chipping (grade 2; Fig. 2 o-p). The buccal surface of RDQ47F/72 is characterized by two deep rectilinear and

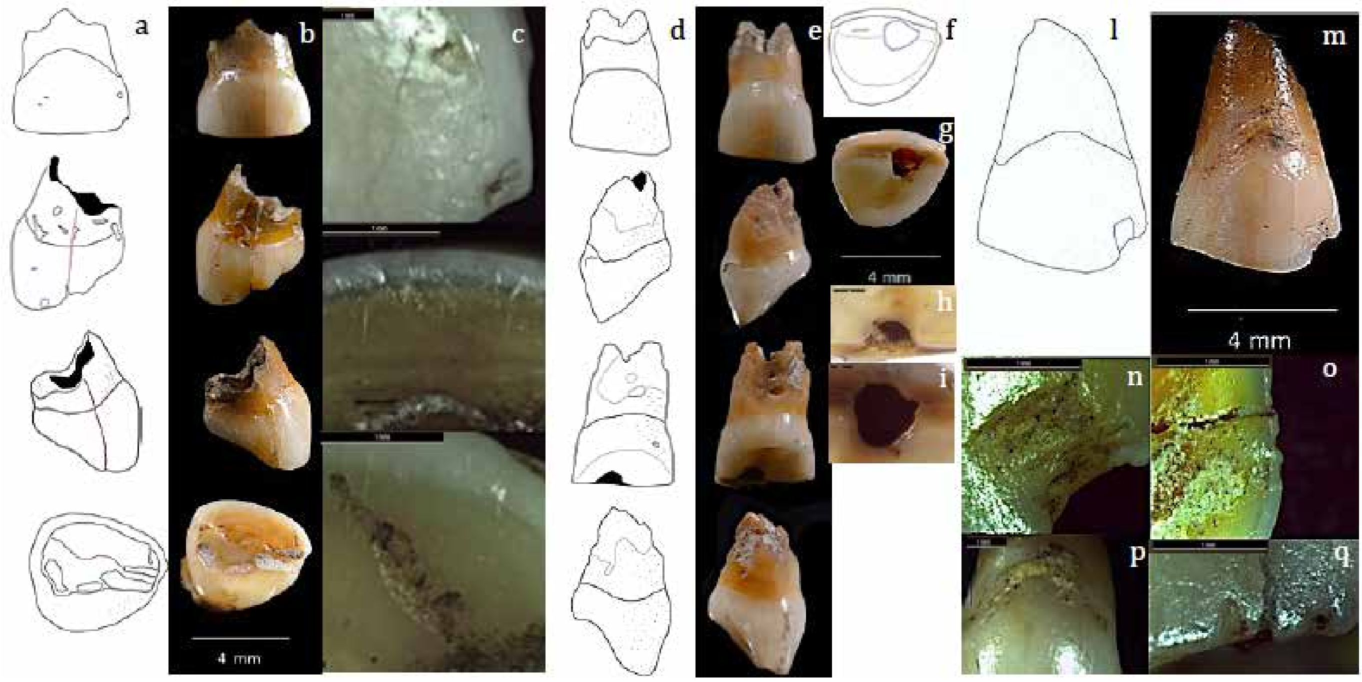


Fig. 2 - *a)a-c) RDQ48M/14; d-i) RDQ47/14a; l-q) RDQ44M/22. / a-c) RDQ48M/14; d-i) RDQ47/14a; l-q) RDQ44M/22*

parallel grooves (Fig. 3 g). Overall, the incisors are attributable to the stage 13 of Ubelaker (7 ± 24), whereas m_1 to the stage 16 (10 ± 30). The wear varies from stage 6 of first incisors to stage 7 of second incisors and first molar (Molnar, 1972). If compared with other specimens of the same age, the degree of wear of first incisors is comparable to that of Fum4 (Benazzi *et al.*, 2012), instead it is higher compared to the current average (Tab. 2 b).

The skeleton VZa has been subject to restoration in the past (Fig. 4 a). The skull is ovoid, it has got vertical frontal bone, sharp glabella, protruding brow arches, quadrangular orbits, large nasal cavity (nasal index > 51), left parietal hole and right supraorbital notch. A formation with osteophytic edges, projecting and circumscribed, insists in the lower portion of the right acoustic meatus (Fig. 4 n). The mandible is slender with alveolar resorption in right and left M_3, exposure of the pulp chamber in left M_1 and M_2 and secondary dentine in right M_1 and M_2 (Fig. 4 i). Right ulna and radius show anomalous latero-medial bending, interosseous margin deformation and flattening of distal ends (Fig. 4 f). The shape of the sciatic notch and the preauricular sulcus assign the skeleton to a female individual (Fig. 4 l-m). The auricular surface of the ileum, characterized by macroporosity and irregular edges, is attributable to the stage 7 of Lovejoy (50-59 years). Also, VZa shows various osteolytic and osteophytic formations on cervical vertebrae (Fig. 4 b-c), left humerus (Fig. 4 g), left ulna and radius (Fig. 4 e). In particular, the proximal epiphysis of the right fibula (Fig. 4 d) is affected by a considerable exostoses (11x19 mm). The height is 152 cm ± 3.72.

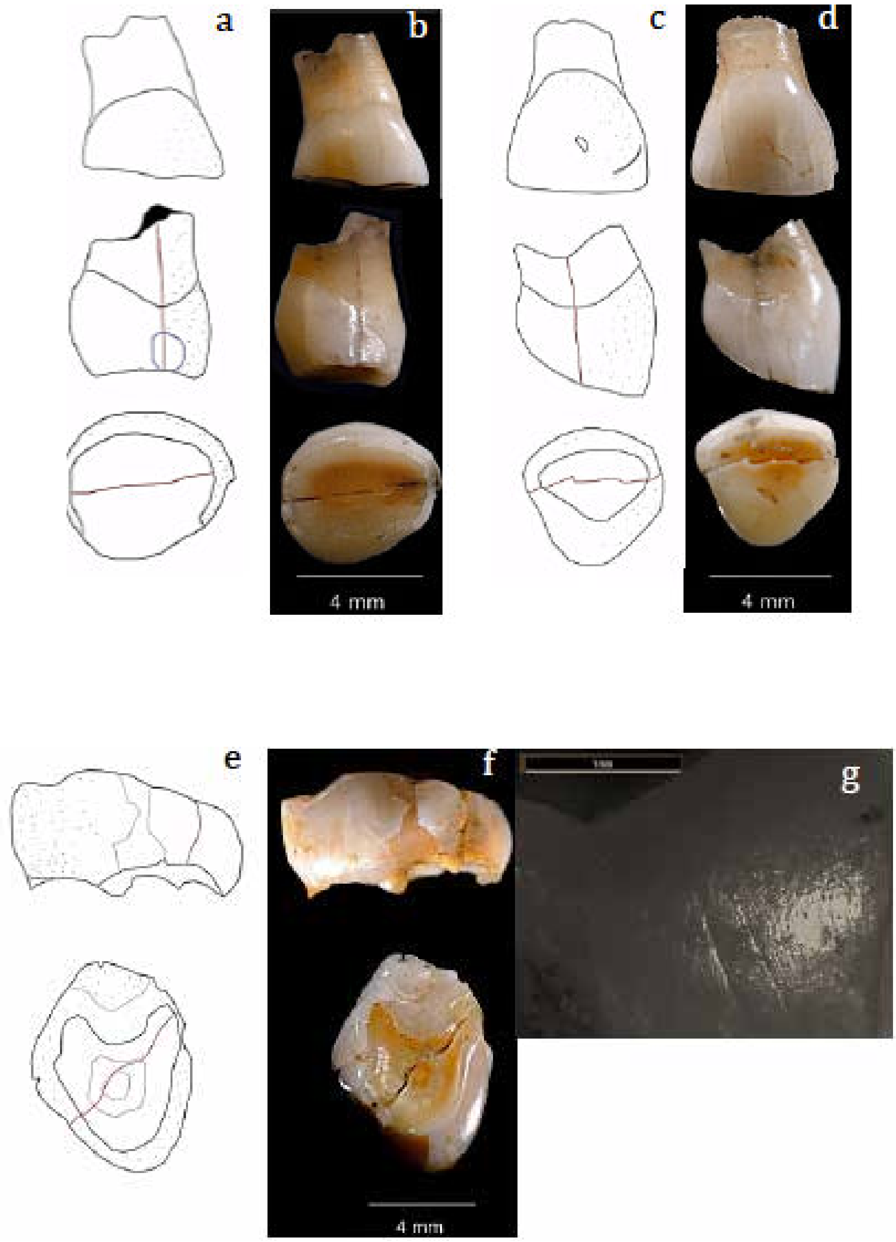


Fig. 3 *- a-b) RDQ42M/26c; c-d) RDQ45F/67; e-g) RDQ47F/72. / a-b) RDQ42M/26c; c-d) RDQ45F/67; e-g) RDQ47F/7.*

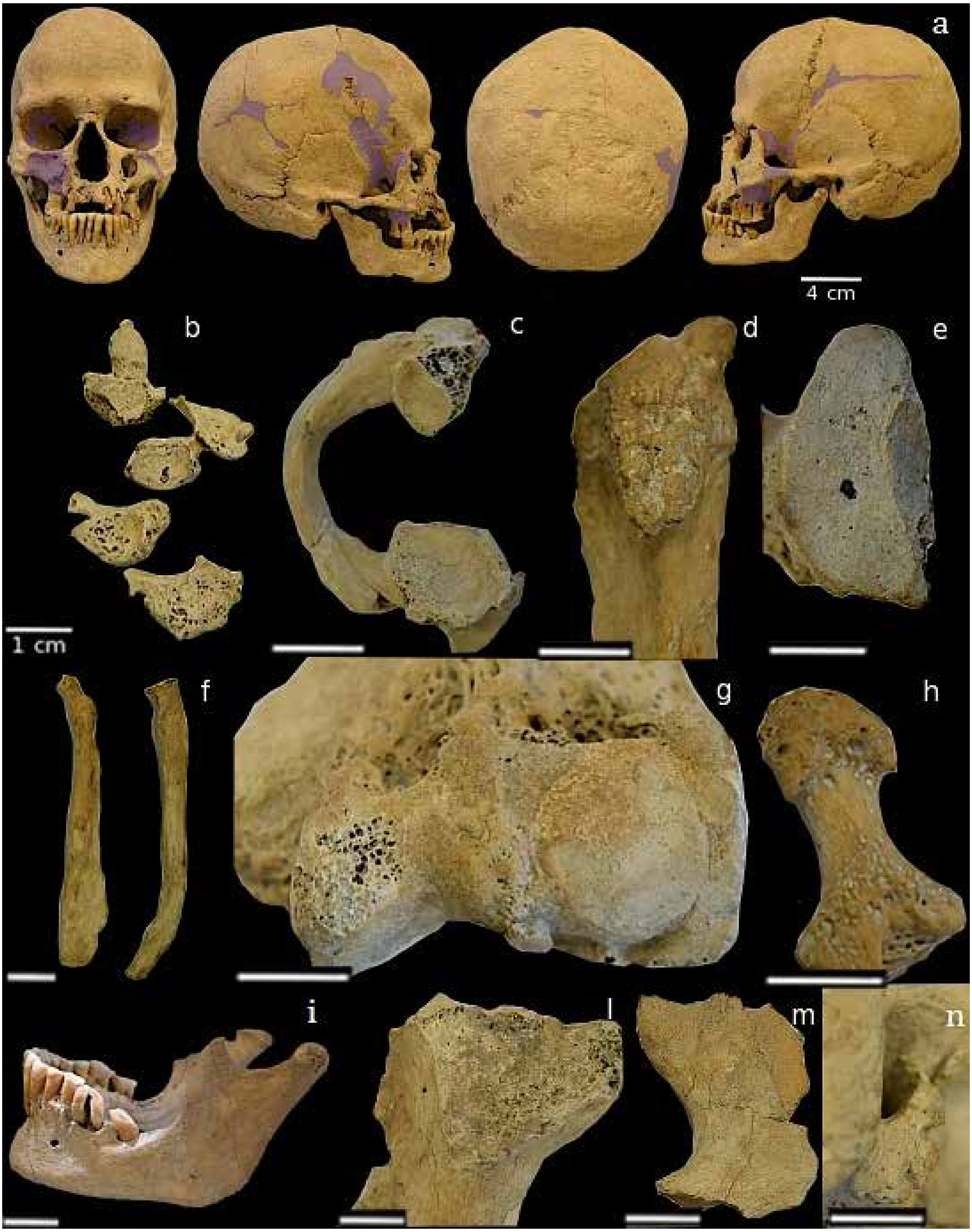


Fig. 4 - *a-n) VZa: a) frontal view, right view, occipital view, left view (blue areas: restoration); b) fragments of cervical vertebrae; c) atlas; d) right fibula; e) left radius; f) right ulna and radius; g) distal epiphysis of the left humerus; h) distal phalanx; i) lower jaw in left view; l) auricular surface of the ileum and preauricular groove; m) sciatic notch; n) right temporal bone. / a-n) VZa: a) cranio in norma frontale, laterale dx, occipitale, laterale sx (in blu le aree restaurate); b) frammenti vertebre cervicali; c) atlante; d) fibula dx; e) radio sx; f) ulna e radio dx; g) epifisi distale omero sx; h) falange distale; i) mandibola in norma laterale sx; l) superficie auricolare ileo e solco preauricolare; m) incisura ischiatica; n) osso temporale dx.*

Tab. 2 - a) MD and BL diameters of RD i1- i2- m1; b) degree of wear (Molnar, 1972) RD-VZa-Vel.R and comparisons (y = years; MPHS = Middle Paleolithic H. sapiens; UPHS = Upper Paleolithic H. sapiens; MESO = Mesolithic; NEO = Neolithic; RHS = Recent H. sapiens). / a) diametri MD e BL in RD i1- i2- m1; b) grado di usura (Molnar, 1972) RD-VZa-Vel.R e confronti (y=anni; MPHS=Middle Paleolithic H. sapiens; UPHS=Upper Paleolithic H. sapiens; MESO=Mesolitico; NEO=Neolitico; RHS=Recent H. sapiens).

a

	N	48M/14	45F/h67	SD	N	47H/i14a	44M/i22	42M/h26c	SD	47F/h72
MD	2	6,7	6,1	0,6	3	5,5	5,3	5,9	0,4	9,2
BL	2	5,2	5,6	0,22	3	5,2	5,1	5,1	0,1	6,1

b

ID	Teeth	Age	Wear
48M14 (UPHS)	i1	7y	6
47H/i14a (UPHS)	i2	7y	7
44M/i22 (UPHS)	i2	7y	7
42M/h26c (UPHS)	i2	7y	7
45F/h67 (UPHS)	i1	7y	6
47F/h72 (UPHS)	m1	10y	7
Fum4 (MPHS)	i1	6y	6
RHS 1	i1	5y	3
RHS 2	m1	10y	3
RHS 3	i2	5y	3
VZa (MESO)	M1	50-59y	8
Vel1 (NEO)	M1	45-55y	5

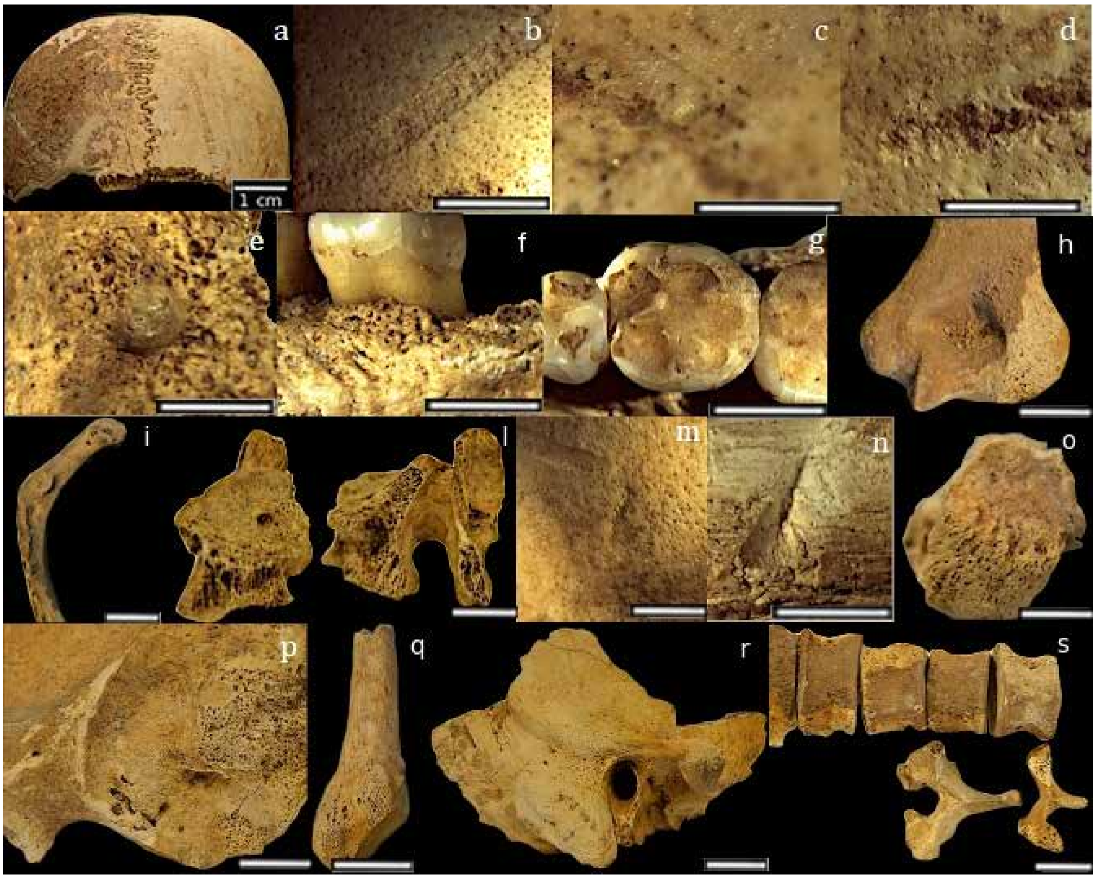


Fig. 5 - a-s) Vel.R: a) skullcap; b) lesion n.3; c) lesion n.2; d) lesion n.9; e) right jawbone; f) right alveolar arch, lingual surface; g) wear of P2-M1-M2; h) distal epiphysis of the humerus; i) left rib; l) T12 vertebra; m) lesion n.7; n) lesion on the right tibia; or) right heel; p) right auricular surface of the ileum; q) 5° left metatarsal; r) right temporal bone; s) thoracic and lumbar vertebrae. / a-s) Vel.R: a) calotta cranica; b) lesione n.3; c) lesione n.2; d) lesione n.9; e) osso mascellare dx; f) arcata alveolare dx, faccia linguale; g) usura P2-M1-M2; h) epifisi distale omero dx; i) costa sx, vista inferiore; l) frammento vertebra T12; m) lesione 7; n) lesione tibia dx; o) calcagno dx; p) superficie auricolare ileo dx; q) 5° metatarsale sx; r) temporale dx; s) vertebre toraciche e lombari.

The neurocranium of Vel.R consists of occipital bone, two parietal bones and right temporal bone. The right parietal bone is covered by a layer of manganese, carbonate and iron oxide. The mastoid appears massive (Fig. 5 r), the inion is prominent and wormian bones are visible in proximity to the medio-lambdoid sutures. Root exposure in right M_2 (Fig. 5 f) and periosteal reaction of the alveolar bone associated with periodontal disease. Enthesopathies on the right olecranon fossa (Fig. 5 h), 5th left metatarsal (Fig. 5 q) and marked enthesis on the right heel (Fig. 5 o). The T12 shows a cranio-caudal crushing and, superiorly, an oval osteolytic area with maximum diameter 7,2 mm (Fig. 5 l). The right tibia diaphysis is crossed by a latero-medial longitudinal lesion (17,3 x 4 mm) with sharp margins and bone reaction on the edge (Fig. 5 n). The shape of the iliac crest and the auricular surface (Fig. 5 p) denote a male individual, between 45 and 49 years old (stage 6, Lovejoy).

Concerning Vel.02, the glabella and the occipital protuberance are not very marked. It is a female not so robust and tooth wear indicate an age of about 40-45 years (Fig. 6).

The skeleton of the individual Ro.13 is very fragmented (Fig. 6 b), the only preserved portions are: left temporal squama; right scapula and a fragment of the left clavicle; part of the hip bone and ischium; right and left femurs, and right tibia. The length of diaphysis indicates that it is a child of about seven months ± 5.

3.2. Digital analysis

The distribution of curvatures of VZa highlighted structures not otherwise visible through the macroscopic examination. At the level of the mandibular condyles there is a massive concentration of pits and porosity with negative values of the histogram above the right condyle (Fig. 7 c). This is characterized by two central grooves (K = 1,20)[7] surrounded by minor depressions (K = 1,18) connected between them by a more superficial circular groove (K = 1,11). On the cranial external plate 10 circular depressions have been identified, with maximum diameters from 11 to 19 mm, localized on the left parietal bone (Fig. 7 a), perfectly aligned, with the same curvature value (K = 1,13). Different appears a further depression located on the right parietal, behind the coronal suture (Fig. 7 b). It has a maximum diameter of 26,9 mm, oval shape and greater curvature factor (K = 1,20).

The skull of Vel.R is characterized by 9 longitudinal lesions (Fig. 8) with partial loss of substance (Fig. 5 b, c, d, m), variable length (23-45 mm) and almost constant width (3,26 to 3,50 mm). They are partly covered by concretions (Fig. 5 d). The lesion 1 is located in front on the right parietal, at about 11 mm from the sagittal suture and extends to the antero-posterior direction. The same lesion is characterized by two thin incisions (Fig. 5 c) which run parallel to it (K = 1,2). The lesions 2 and 5 are on the left parietal, behind the coronal suture, respectively at 23 and 51 mm from the sagittal suture. The lesions 3 and 4 extend across the left parietal bone, and they are located at about 31 and 33 mm from the sagittal suture. The lesion 7, on the left parietal bone (Fig. 5 m), shows different orientation and periosteal reaction along the edges (length 7,9 mm; K = 1,14).

The lesion 8, at the rear of the previous one, approaches the contour of the sagittal suture assuming a curved shape. The lesion 9 is located on the right parietal bone, at about 10 mm from the sagittal suture and, below, to 6 mm from the lambdoid suture. All lesions, except n. 7, show bone bridges (K = 0,86), irregular base, thin sides, and sharp edges.

The right maxillary is characterized by a proliferation of compact spherical bone placed below the infraorbital edge, width 4,47 and height 2,74 mm (Figs. 5, 8 c-d).

3.3. Morphometry and multivariate statistical analysis

The first incisors show different mesio-distal (MD) and bucco-lingual (BL) diameters (Tab. 2). The measures on RDQ48M/14 are 6,7 mm in MD and 5,2 mm in BL, while RDQ45F/67 has a MD diameter of 6,1 mm and 5,6 mm BL. Second incisors, RDQ47/14a, RDQ44M/22 and RDQ42M/26c, show a significant divergence in MD diameters (respectively 5,5-5,3-5,9 mm) and similar measures in BL (respectively 5,2-5,1-5,1 mm). The first molar RD47F/72 is bigger than recent deciduous specimens (MD = 9,2; BL = 6,1 mm).

Out of 19 specimens from Trento, shown in table 1, the horizontal-cranial index registers a mean value of 75,5 in the Mesolithic increasing progressively up to the Bronze Age (77,3). The vertico-longitudinal i. changes from 75,2 to 69,6 during the Mesolithic and the Bronze Age. The average of the vertico-trasversal i. is 98,9 in the Mesolithic and gradually decreases in the later stages. The nasal i. starts with 50,8 of the Mesolithic and reaches intermediate values between 46,3 and 49,2 in the later stages. Stands the discontinuous trend of the orbital i. with an increase between Eneolithic and Bronze Age (79,2-81,92). Except for the value 49,03 of the Mesolithic, the superior-facial i. remains substantially unchanged (Fig. 9).

The statistics, developed starting from the cranial index of 45 specimens (Tab. 2), detect 56,9% of shared features among individuals of European Paleolithic and Mesolithic of the Eastern Alps. In Trentino - A. Adige between Mesolithic and Neolithic the similarity is 50,8%, while the affinity increase up to 61,4% in the period between Neolithic and Bronze Age.

The PCA, built on 45 individuals according to 15 standard landmarks in lateral view, shows different combinations (Fig. 10). For paleo-mesolithic stage, Vatte di Zambana and Kaufertsberg (Kau) reveal strong morphological affinity (88,2%), while decreases the degree of similarity with respect to peninsular specimens: Grimaldi (61,9%); S. Teodoro II (62,3%); Ortucchio (64,4%). About the Neolithic it is visible

Fig. 6 - *a) individual Vel.02. / a) individuo Vel.02.*

Fig. 6 - *b) individual Ro.13. / b) individuo Ro.13.*

7 K=curvature factor. Range: 0.7– 1.2.

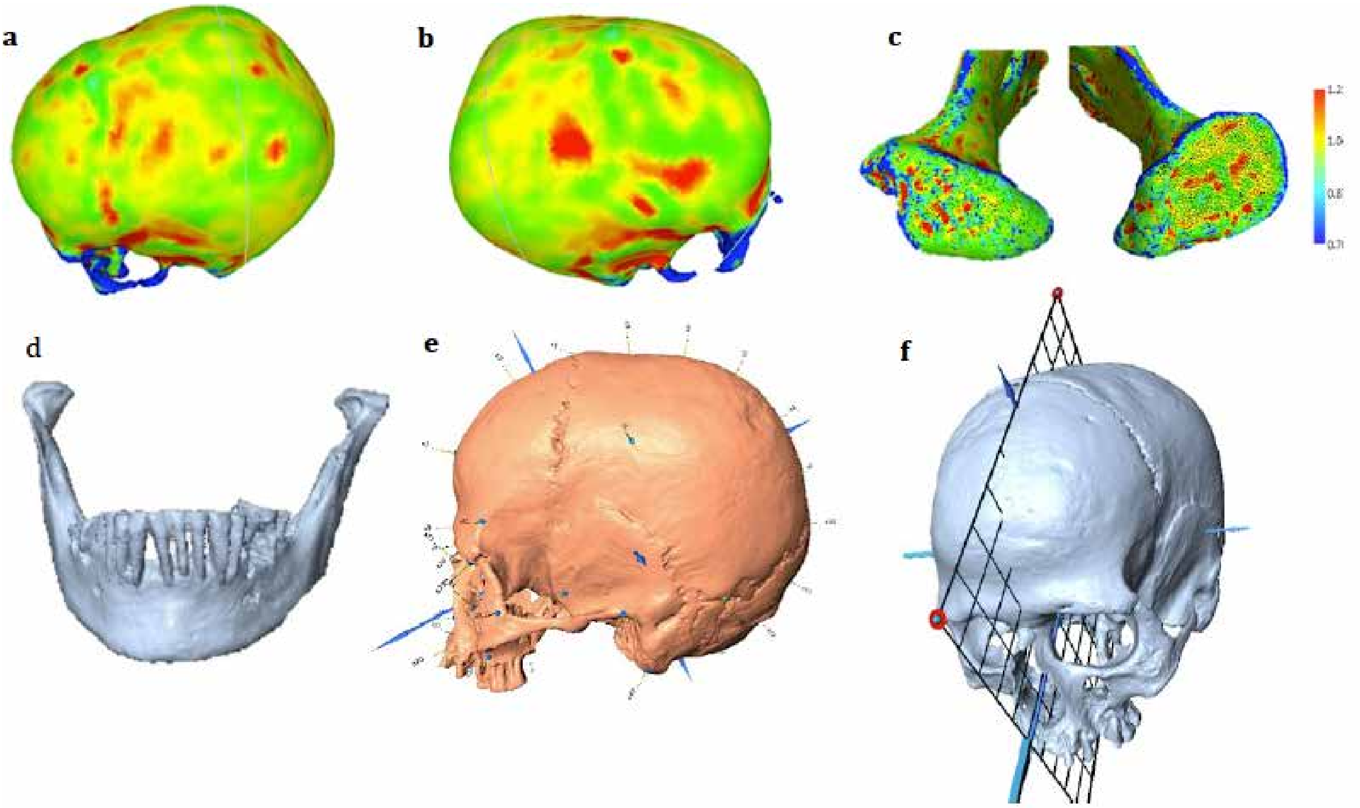


Fig. 7 - *a-f) VZa: a-b) distribution of curvatures on the skull; c) distribution of curvatures on left and right condyles; d) 3D model of the jaw; e) 3D landmarks; f) grid along the sagittal plane for the positioning of landmarks. / a-f) VZa: a-b) distribuzione delle curvature sul cranio; c) distribuzione delle curvature sui condili sx e dx; d) modello 3D mandibola VZa; e) landmarks 3D; f) griglia lungo il piano sagittale per il posizionamento dei landmarks.*

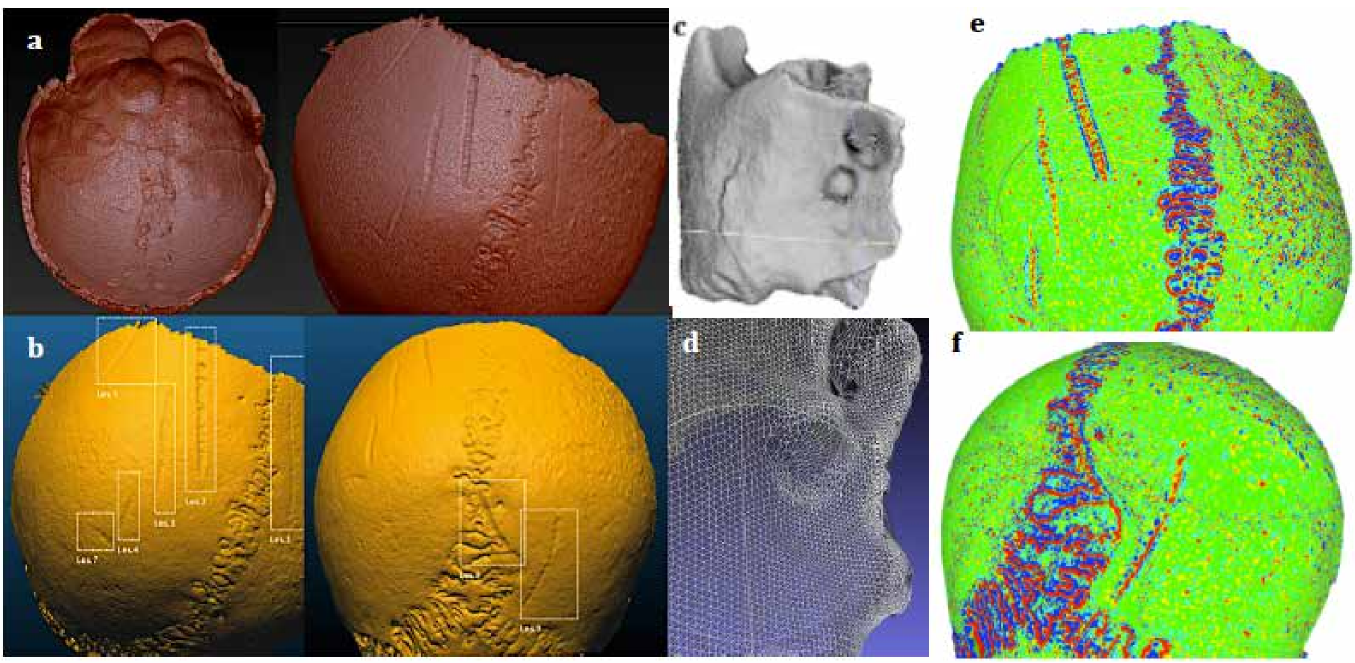


Fig. 8 - *a-f) Vel.R: a) skull; b) lesions n. 1-9; c) 3D model, right zygomatic and maxillary; d) 3D vectors of the right jawbone; f) distribution of curvatures, superior and occipital views. / a-f) Vel.R: a) cranio; b) lesioni n. 1-9; c) modello 3D, zigomatico e mascellare dx; d) nuvola di punti e nodi vettoriali del mascellare destro; e-f) distribuzione delle curvature, norme superiore e occipitale.*

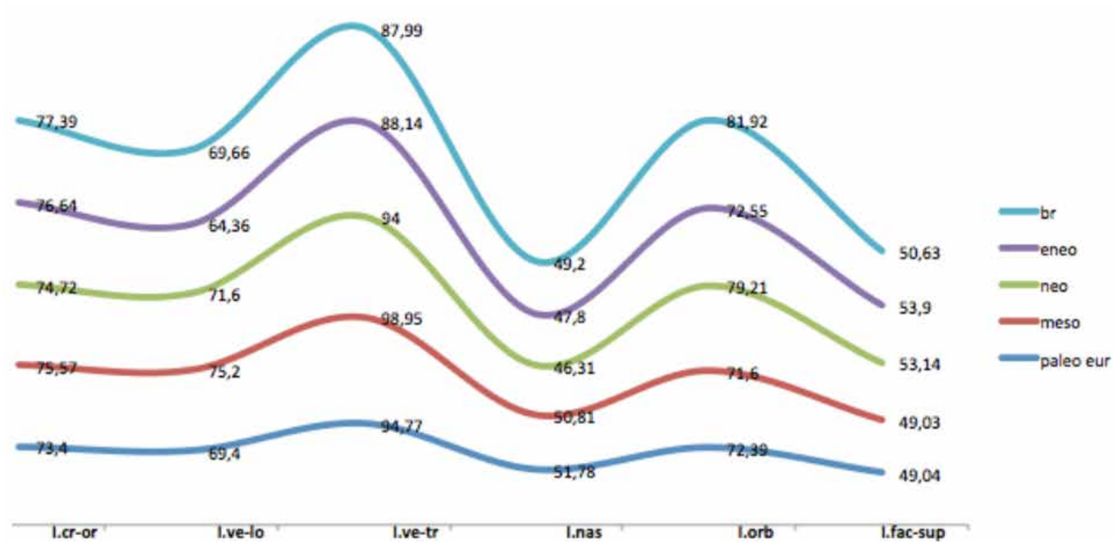


Fig. 9 *- cranial indexes in the Eastern Alps (N.19) and comparison with european Paleolithic. / indici cranici nell'area alpina orientale (N.19) e confronto con Paleolitico europeo.*

a clear separation between the series of La Vela and groups from Fornace Cappuccini (FC) and Passo di Corvo (PC). Vel.01, Vel.02, Vel.2-76 show reciprocal matches (86,4%) and with Remedello group (84,2%). In addition, significant distance between eneolithic specimens of Lasino (Co1-Co2) than Vel.01-Vel.02. Regarding the Bronze Age all individuals in the pile-dwelling site of Fiavè (Fi A-B-C-F-H-D) show a close relationship between them (94,9%).

In the thin-plate spline conducted on VZa the main differences, compared to other specimens of the sample, focus on the cranial vault (Fig. 12 b). A direct comparison between VZa and Kau (Fig. 12 c) indicates moderate differences at the level of glabella and occipital protuberance. In the thin-plate spline drawn up on the cranial vault of neo-eneolithic and Bronze Age individuals, differences are limited to the lower portion of the occipital crest (Fig. 12 d). The grids, built on 19 specimens from Trentino – A. Adige (Fig. 11), in frontal and lateral view, denote a progressive expansion of glabellar and occipital portions, height reduction of the cranial vault, narrowing of the minimum frontal width, raising of orbits and nasal cavity.

The final matrix of biological distances (Tab. 4 a-b) can be considered effective for values between 0 and 5 (the 5th stage denotes a high level of similarity between specimens). Within this range fall the following units: VZa-Ort (4,9); VZa-Kau (4,3); Vel.01-Vel.02-Vel2-76 (1,6; 4,5; 4,9); Rem-FiH (4,9); Fi A-B-C-D-F-H (between 2,7 and 4,2); FC-PC (2,12); Qu-Poy (2,85).

Tab. 3 *- a) summary of 2D/TPS statistics (six variables and 45 observations); b) percentage of similarity from the Paleolithic to the Bronze Age (N.45); c) percentage of similarity between Mesolithic and Neolithic specimens from Trentino-A. Adige (N.9); d) percentage of similarity from the Neolithic to the Bronze Age (N.14); e) percentage of similarity between European Palaeolithic and Mesolithic specimens from Trentino-A. Adige (N.7). / a) sommario statistiche 2D/TPS su 6 variabili e 45 osservazioni estratte dal campione; b) percentuale similarità dal Paleolitico all'età del Bronzo (N.45); c) percentuale similarità su esemplari trentini tra Mesolitico e Neolitico (N.9); d) percentuale similarità degli esemplari trentini dal Neolitico all'età del Bronzo (N.14); e) percentuale similarità tra esemplari europei del Paleolitico e trentini del Mesolitico (N.7).*

a

	I.cr-or	I. ve-lo	I. ve-tr	I.nas	I.orb	I. fac-sup
N	45	45	45	45	45	45
Min	68,7	61,6	80,2	38,7	56,25	43,9
Max	81,61	80,64	111,1	66,03	89,2	55,2
Mean	75,163	71,374	93,917	49,378	76,083	50,580
Stand. Error	0,428	0,663	1,113	0,629	0,921	0,435
Variance	8,263	19,783	55,734	30,918	38,160	8,533
Stand. Dev.	2,874	4,448	7,466	5,560	6,177	2,921
Median	75,5	78,87	92,55	49,01	75,2	50,3
25 prcntil	73,03	68,735	88,35	45,55	71,575	48,69
75 prcntil	76,86	74,995	99,6	52,675	80	53,9
Skewness	-0,107	-0,090	0,323	0,494	-0,288	0,360
Kurtosis	-0,129	-0,468	-0,356	1,113	1,378	-0,494
Geom. Mean	75,109	71,237	93,630	49,077	75,831	50,496
Coeff. Var.	3,824	6,232	7,949	11,261	8,119	5,775

b

Axis	Eigenvalue	%
1	0,002	44,004
2	0,001	35,608
3	0,000	10,636
4	0,000	7,357
5	9,59E-5	2,395

c

Axis	Eigenvalue	%
1	0,001	50.837
2	0,000	24,912
3	0,000	18,293
4	7,49E-5	4,132
5	3,31E-5	1,825

d

Axis	Eigenvalue	%
1	0,001	61,412
2	0,001	22,51
3	0,000	11,361
4	0,000	8,058
5	7,11E-5	2,659

e

Axis	Eigenvalue	%
1	0,002	54,938
2	0,001	22,686
3	0,001	11,601
4	0,000	5,588
5	9,39E-5	2,187

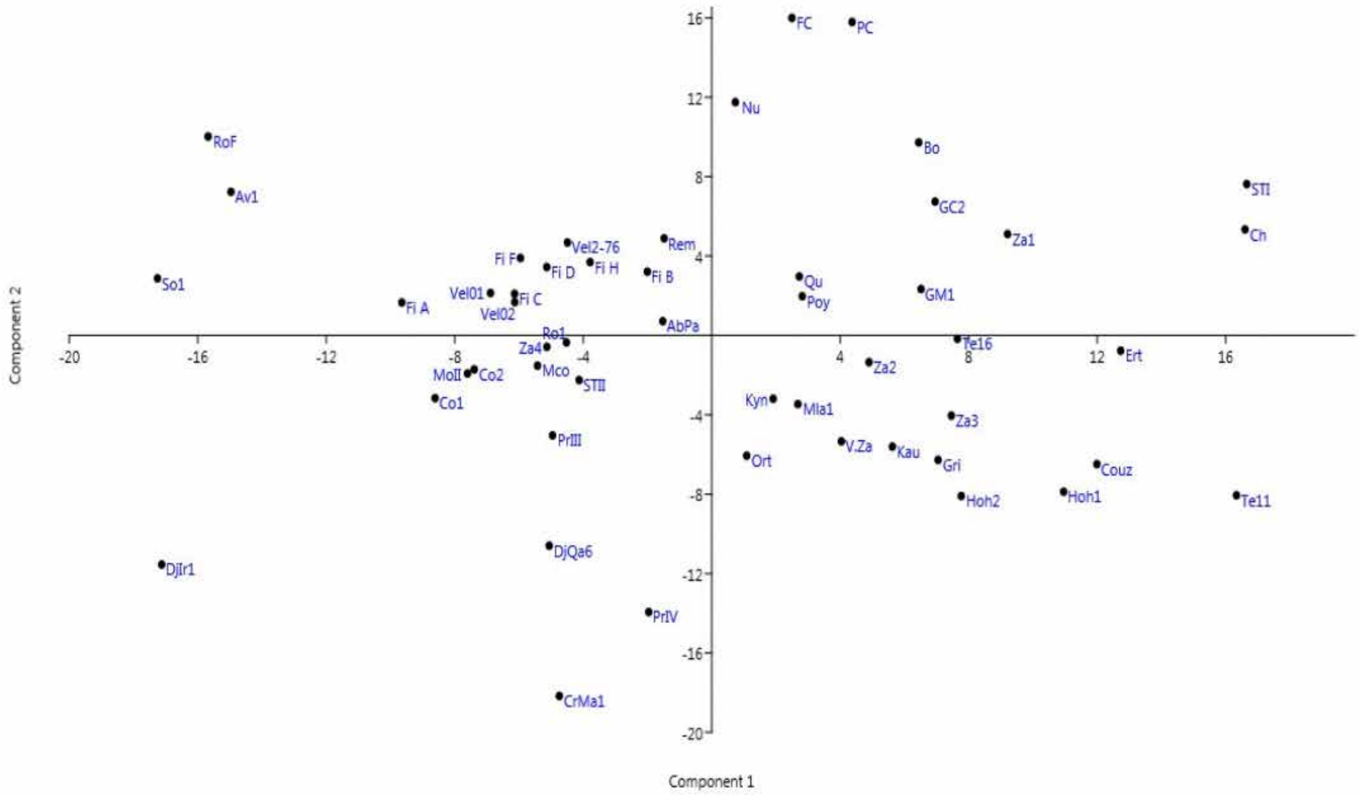


Fig. 10 - *cranial indexes in the Eastern Alps (N.19) and comparison with european Paleolithic. / indici cranici nell'area alpina orientale (N.19) e confronto con Paleolitico europeo.*

4. Discussion and conclusions

The results showed differences in morphology and size of RD specimens compatible with the belonging of deciduous teeth to six different individuals. The dental micro-macrousure, similar to those of Fumane 4 of the Middle Paleolithic, but distant compared to current specimens, could reflect a diet rich in leathery foods and a non-food use of dental arches also among children during the Upper Paleolithic. The circular hole on the occlusal surface of RD-Q47/14a is probably due to intentional modifications in accordance with the assumptions of Villa & Giacobini (2006), by reflecting on the possible use of deciduous teeth for ritual and / or ornamental purposes. The particular shape of the root on RDQ42/26c, RD-Q45F/67, and RDQ47F/72 presumably refers to the spontaneous

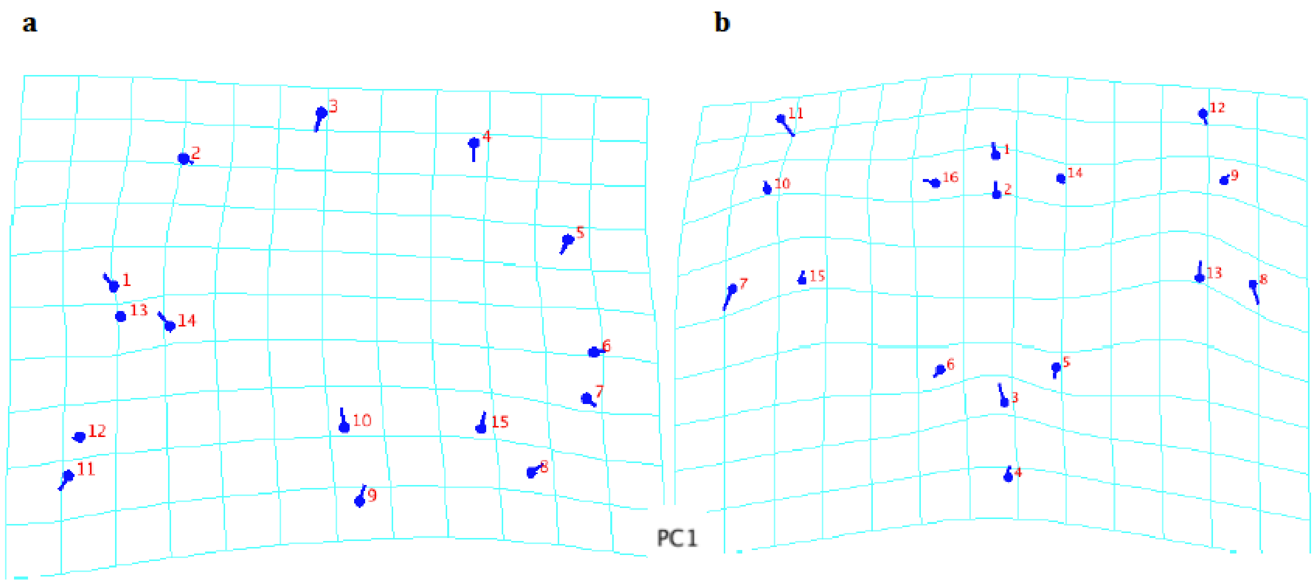
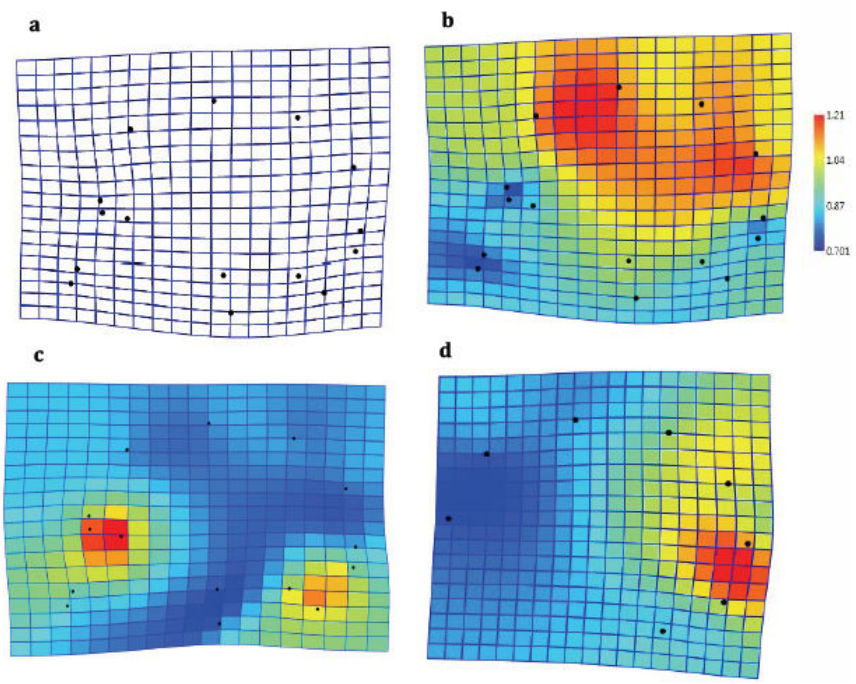


Fig. 11 - *modifications of the skull from the Mesolithic to the Bronze Age of Eastern Alps in lateral view, 15 landmarks (a) and frontal view, 16 landmarks (b). / modificazioni del distretto cranico dal Mesolitico all'età del Bronzo nell'area alpina orientale in norma laterale, 15 landmarks (a) e norma frontale, 16 landmarks (b).*



e

Axis	Eigenvalue	%
1	0,000	42,921
2	0,000	30,971
3	0,000	13,768
4	8,40E-5	7,211
5	3,76E-5	3,231
6	2,20E-5	1,897

f

Axis	Eigenvalue	%
1	5,34E-4	88,256
2	5,97E-5	9,871
3	1,13E-5	1,874

g

Axis	Eigenvalue	%
1	1,53E-4	93,345
2	4,16E-6	2,655

Fig. 12 *- Thin-plate Spline 2D/TPS; a) deformation grid; b) expansion factor and percentage of similarity of VZa compared with the average (N.45); c-f) expansion factor and percentage of similarity between VZa and Kau; d-g) expansion factor of the cranial vault and percentage of similarity between Neo-Eneo-Br groups from Trentino-A.Adige (N.14). / Thin-Plate Spline 2D/TPS; a) griglia di deformazione; b-e) fattore di espansione e percentuale di similarità dell'esemplare VZa in rapporto alla morfologia media (N.45); c-f) fattore di espansione e percentuale di similarità tra VZa e Kau; d-g) fattore di espansione della volta cranica e percentuale di similarità tra i gruppi trentini Neo-Eneo-Br (N.14).*

tooth loss. Bevelled edges of the chipping in RDQ44M/22 demonstrate that they have been produced *intra-vitam* and triggering factors may be related to the mastication of foreign bodies.

Macro-microscopic and digital analysis of VZa showed diffuse alterations of an osteoarthritic nature and inflammation of the temporo-mandibular right joint. The marked wear of left molars and the consumption of the right condyle show an asymmetrical masticatory cycle. This aspect supports the hypothesis about the use of teeth because of the tanning leather procedure (Ortner, 1985), amply attested by the archaeological remains of the Eastern Alps. The depressions of the external cranial surface are *post-mortal* and can be related to the pressure exerted by the overlying rocks with which the burial had been covered. The perfect alignment denotes a particular care in the arrangement of stones, probably linked to a precise funeral ritual (Vercellotti, 2008; Broglio, 1995). Abnormalities at the level of forearms represent the results of a double fracture of the third-distal right radius and fracture of the left olecranon turned into serrate pseudoartrosis, in accordance with the description given by Graziati (1976). It is likely that lesions were produced at a young age, but is more difficult to determine if both are connected to the same event. Traumatic injuries in VZa accord well with a lifestyle characterized by intense physical activity typical of Mesolithic groups dedicated to the harvest, fishing and hunting of wild rock goats and deer.

The analysis performed on Vel.R showed characteristics that can be discovered only through direct comparison with other individuals of the same necropolis. Here, failing to provide the full skeletal series, we have been limited to describing the individual case. Bone reactions visible on esocranial lesions demonstrate typical phenomena of tissue that is preparing to the reparation phase. We can suppose that the wounds have been engraved *ante-mortem* by a mechanical tool with a wide blade, at a short time between each other. The collapse of the T12 appears the result of a fracture of the vertebral body with Schmorl nodule (Lowell, 1997), while the tibia injury appears to have been caused by a sharp instrument when the individual was still alive. Anomalies on the heel could be associated with stress and inflammation of the Achilles tendon due to repeated microtrauma and orthotic iperflessions. The lesion found in the jawbone is attributable to an osteoma with central *nidus* surrounded by an extremely compact sclerotic bone reaction (Fornaciari & Giuffra, 2009).

The set of data acquired by geometric morphometric emphasizes the tendency to differentiation of groups from Trentino-A. Adige compared to peninsular groups. Peculiar is the case of vertico-trasversal and orbital indexes that show significant divergences between specimens from Trentino and the rest of the sample. Compared to the average of the Italian peninsula during the paleo-mesolithic period, the pattern of variability of the individual VZa contrasts, especially for its *ipsicrania*, but it is similar to specimens from Bavarian Alps. On the southern slope of the Eastern Alps, during the Mesolithic, it seems settled on a persistence of the anatomical features typical of Paleolithic groups from the Balkans that would have moved along the Danube to the west both north and south of the Alps (Broglio, 1995).

The Neolithic is a period of deep changes not only in the methods of subsistence but also in skeletal morphology. Anthropological results seem to agree with archaeological data about the arrival of new human groups that gradually supplanted the clan settled in rock shelters along the valley during the Mesolithic, on the edge of the Adige Valley basin. Morphological similarities between individuals of the neo-eneolithic stations from Trentino-A. Adige and Bresciane Prealps indicate population movements towards the foothill areas and along valleys by groups having the same origin. The next chronological phase, Early Bronze Age, testifies homogeneity and a less pronounced internal variability.

The quantitative traits showed a slight antero-posterior expansion of cranium, reduction in height of the vault, moderate lifting of the orbits, the asymmetry of piriform aperture, raising and narrowing

Tab. 1 - Sample (Paleo = Paleolithic, Meso = Mesolithic; Neo = Neolithic; Eneo = Eneolithic; Br = Bronze Age; AMHR = Anatomically Modern Human-present). Outgroups: Nu; Za 1-4; Av1. / Campione di studio (Paleo=Paleolitico; Meso=Mesolitico; Neo=Neolitico; Eneo=Eneolitico; Br=età del Bronzo; AMHr=uomo anatomicamente moderno-attuale). Outgroups: Nu; Za 1-4; Av1.

ID	Sex	Specimens	Origin	Chronology
1	F	Ort	Grotta la Puntà, Ortucchio, Fucino (Abruzzo, Italy)	Paleo
2	M	STI	Messina, San Teodoro (Sicily, Italy)	Paleo
3	F	STII	Messina, San Teodoro (Sicily, Italy)	Paleo
4	M	Ch	Chancelade (France)	Paleo
5	M	PrIII	Předmostí, Moravia (Czech Republic)	Paleo
6	F	PrIV	Předmostí, Moravia (Czech Republic)	Paleo
7	M	Gri	Grimaldi, Imperia (Liguria, Italy)	Paleo
8	M	DjIr1	Djebel Irhoud (Marocco)	Paleo
9	M	CrMa1	Cro Magnon (France)	Paleo
10	M	DjQa6	Djebel Qafzeh (Israel)	Paleo
11	M	Mla1	Mladec, Lautsch (Czech Republic)	Paleo
12	F	AbPa	Abri Pataud (France)	Paleo
13	M	Vbru	Riparo Villabruna, Belluno (Veneto, Italy)	Paleo
14	M	Couz	Couzoul de Gramat (France)	Meso
15	M	Kau	Kaufertsberg, Baviera (Ofnet, Germany)	Meso
16	M	Hoh1	Hohlenstein, Baden-Wurttemberg (Germany)	Meso
17	F	Hoh2	Hohlenstein, Baden-Wurttemberg (Germany)	Meso
18	F	VZa	Vatte di Zambana, Trento (Trentino-A.Adige, Italy)	Meso
19	M	MoII	Grotta della Molara, Palermo (Sicilia, Italy)	Meso
20	F	Mco	Mezzocorona, Trento (Trentino-A.Adige, Italy)	Meso
21	M	Ert	Erteboelle (Denmark)	Meso
22	M	Te11	Teviec, Brittany (France)	Meso
23	M	Te16	Teviec, Brittany (France)	Meso
24	M	Vel.R	La Vela, Trento (Trentino-A.Adige, Italy)	Neo
25	F	Vel01	La Vela, Trento (Trentino-A.Adige, Italy)	Neo
26	F	Vel02	La Vela, Trento (Trentino-A.Adige, Italy)	Neo
27	F	Vel2-76	La Vela, Trento (Trentino-A.Adige, Italy)	Neo
28	N	Qu	Quinzano, Verona (Veneto, Italy)	Neo
29	M	FCK3	Fornace Cappuccini, Faenza (Emilia-Romagna, Italy)	Neo
30	F	PC9	Passo di Corvo, Foggia (Puglia, Italy)	Neo
31	N	Poy	Poysdorf (Austria)	Neo
32	ND	Chi	Chiarano d'Arco, Romazzolo, Trento (Trentino-A.Adige, Italy)	Neo
33	N	Rem	Remedello, Brescia (Lombardia, Italy)	Neo
34	M	Bo	Borreby (Denmark)	Neo
35	M	Kyn	Kyndeloese (Denmark)	Neo
36	M	GM1	Grutas de Melides (Portugal)	Neo
37	M	GC2	Grutas de Cascae (Portugal)	Neo
38	M	Co1	Grotta la Cosina, Lasino, Trento (Trentino-A.Adige, Italy)	Eneo
39	M	Co2	Grotta la Cosina, Lasino, Trento (Trentino-A.Adige, Italy)	Eneo
40	M	Le	Ledro, Trento (Trentino-A.Adige, Italy)	Br
41	M	So1	Solteri, Trento (Trentino-A.Adige, Italy)	Br
42	M	Fi A	Fiavè, Trento (Trentino-A.Adige, Italy)	Br
43	F	Fi B	Fiavè, Trento (Trentino-A.Adige, Italy)	Br
44	M	Fi C	Fiavè, Trento (Trentino-A.Adige, Italy)	Br
45	M	Fi D	Fiavè, Trento (Trentino-A.Adige, Italy)	Br
46	F	Fi F	Fiavè, Trento (Trentino-A.Adige, Italy)	Br
47	F	Fi H	Fiavè, Trento (Trentino-A.Adige, Italy)	Br
48	F	Ro1	Romagnano, Trento (Trentino-A.Adige, Italy)	Br
49	F	RoF	Romagnano, Trento (Trentino-A.Adige, Italy)	Br
50	F	Nu	Nubia (Africa)	Br
51	M	Za1	Zalavar, Budapest (Hungary)	AMHr
52	M	Za2	Zalavar, Budapest (Hungary)	AMHr
53	M	Za3	Zalavar, Budapest (Hungary)	AMHr
54	F	Za4	Zalavar, Budapest (Hungary)	AMHr
55	M	Av1	Zalavar, Budapest (Hungary)	AMHr

Campione
F 18; M 33; N 3; ND 1
Esemplari Alpi Orientali=19
tot. 55 unità
ID= codice identificativo
F= sesso femminile
M= sesso maschile
N= media necropoli
ND= sesso non determinabile

Tab. 4 *- a,b) matrix of biological distances (N.28; Euclidean metric; UPGMA algorithm). / a,b) Matrice delle distanze biologiche (N.28; metrica Euclidea; algoritmo UPGMA.*

a

	Ort	Gri	Couz	Kau	Hoh1	Hoh2	V.Za	MoII	Vel01	Vel02	Vel2-76	Qu	FC	PC	Poy
Ort	0	10.915214	11.381125	6.4707032	12.049481	9.486833	4.9566017	13.535132	13.595588	13.128976	13.278705	10.679888	22.329801	22.368424	9.6286032
Gri	10.915214	0	8.3258573	12.762441	12.040594	10.671921	11.131101	21.596354	21.233321	20.514237	19.173114	12.908443	24.437305	23.846021	11.947799
Couz	11.381125	8.3258573	0	9.5519631	8.8419455	9.4493386	10.339144	23.064124	22.350168	21.58101	20.6496	13.623142	24.801411	23.932664	12.772627
Kau	6.4707032	12.762441	9.5519631	0	8.4474848	8.9347636	4.3081202	18.314797	17.705084	17.181967	16.77671	12.436639	23.049295	22.805798	10.930691
Hoh1	12.049481	12.040594	8.8419455	8.4474848	0	5.574047	7.950088	23.206762	23.951409	23.360651	22.675846	17.376709	26.567085	25.980385	16.118933
Hoh2	9.486833	10.671921	9.4493386	8.9347636	5.574047	0	6.423387	18.863823	20.669785	20.152667	20.016094	16.026852	25.311262	24.909484	15.299346
V.Za	4.9566017	11.131101	10.339144	4.3081202	7.950088	6.423387	0	16.091728	16.50236	16.056833	15.606547	12.080973	22.114654	21.990832	10.810916
MoII	13.535132	21.596354	23.064124	18.314797	23.206762	18.863823	16.091728	0	7.833505	8.6981492	11.382241	16.828541	21.746627	22.625733	17.542229
Vel01	13.595588	21.233321	22.350168	17.705084	23.951409	20.669785	16.50236	7.833505	0	1.6401219	4.9067301	12.352328	17.880157	18.980474	13.602573
Vel02	13.128976	20.514237	21.58101	17.181967	23.360651	20.152667	16.056833	8.6981492	1.6401219	0	4.5854117	11.569356	18.092816	19.13908	12.95608
Vel2-76	13.278705	19.173114	20.6496	16.77671	22.675846	20.016094	15.606547	11.382241	4.9067301	4.5854117	0	8.6387499	14.22786	15.282225	10.123537
Qu	10.679888	12.908443	13.623142	12.436639	17.376709	16.026852	12.080973	16.828541	12.352328	11.569356	8.6387499	0	14.522396	14.488975	2.8513155
FC	22.329801	24.437305	24.801411	23.049295	26.567085	25.311262	22.114654	21.746627	17.880157	18.092816	14.22786	14.522396	0	2.1284736	15.653434
PC	22.368424	23.846021	23.932664	22.805798	25.980385	24.909484	21.990832	22.625733	18.980474	19.13908	15.282225	14.488975	2.1284736	0	15.534877
Poy	9.6286032	11.947799	12.772627	10.930691	16.118933	15.299346	10.810916	17.542229	13.602573	12.95608	10.123537	2.8513155	15.653434	15.534877	0
Rem	11.55422	17.983934	18.345299	13.46514	19.399227	17.500286	12.587053	12.58546	8.1865744	8.1541401	5.2417554	7.5432089	12.481987	13.249091	8.1357237
Bo	17.404135	18.640569	17.960064	15.966274	19.33044	20.056617	16.152393	23.251514	19.259177	18.987362	15.142084	10.412392	10.892103	10.324413	9.8286266
Kyn	8.983663	13.257719	14.492074	8.2756389	10.731738	10.88532	6.175249	18.436176	18.190168	17.876806	16.509179	13.46938	21.876385	21.95934	11.593714
Co1	11.733921	20.499951	22.113817	16.165485	22.923196	20.146982	15.276832	10.353371	10.818175	11.588568	12.638232	15.900343	23.140892	23.82451	15.197661
Co2	12.346052	20.003552	21.512531	17.520588	23.909308	20.289726	16.421775	7.4578013	5.862508	6.3802038	8.9062338	13.711564	21.297582	22.047952	14.393992
So1	20.919027	26.934342	31.072137	25.267206	30.769168	28.197831	23.340968	16.774311	15.716797	16.506959	16.007002	21.415548	24.518273	25.899037	20.977076
Fi A	13.498311	20.414483	23.505923	17.724571	23.29709	20.583304	15.703194	10.886175	8.501788	8.8636561	8.3186057	13.757631	19.231287	20.459462	13.721676
Fi B	10.657457	15.322731	17.747828	12.867921	17.588729	16.137082	11.026582	14.807214	12.334237	12.301683	9.3691729	8.8394231	14.935039	15.487924	7.7863599
Fi C	11.460157	17.473989	20.495199	15.06563	20.375799	18.199099	13.085362	12.599421	9.7578276	9.7767684	7.7991794	10.762862	17.247585	18.220911	10.348198
Fi D	12.827412	20.218012	21.601262	14.910282	20.035631	18.016173	13.047237	12.054821	10.034466	10.269981	8.9745473	12.800254	16.352569	17.482817	12.684893
Fi F	12.662543	17.971642	21.030692	16.415541	21.512554	19.039433	14.358409	12.142479	8.6429162	8.7137822	6.0029993	10.143964	15.314046	16.39251	10.369667
Fi H	11.233294	16.518705	19.082476	14.856275	19.841847	17.25488	12.770082	11.393116	8.4070744	8.5027584	5.5870296	8.5942364	14.034988	14.879291	8.9063404
Ro1	9.0138449	15.266804	18.207784	12.510212	17.928285	16.113268	10.666082	13.576671	11.586777	11.478301	9.9049987	10.442289	18.961893	19.618354	9.2370666
RoF	24.328006	29.337246	33.163834	27.459168	32.380888	30.471625	25.55102	20.736005	18.519933	19.275941	17.249786	22.2711	21.09649	22.687827	21.947162

b

Rem	Bo	Kyn	Co1	Co2	So1	Fi A	Fi B	Fi C	Fi D	Fi F	Fi H	Ro1	RoF
11.55422	17.404135	8.983663	11.733921	12.346052	20.919027	13.498311	10.657457	11.460157	12.827412	12.662543	11.233294	9.0138449	24.328006
17.983934	18.640569	13.257719	20.499951	20.003552	26.934342	20.414483	15.322731	17.473989	20.218012	17.971642	16.518705	15.266804	29.337246
18.345299	17.960064	14.492074	22.113817	21.512531	31.072137	23.505923	17.747828	20.495199	21.601262	21.030692	19.082476	18.207784	33.163834
13.46514	15.966274	8.2756389	16.165485	17.520588	25.267206	17.724571	12.867921	15.06563	14.910282	16.415541	14.856275	12.510212	27.459168
19.399227	19.33044	10.731738	22.923196	23.909308	30.769168	23.29709	17.588729	20.375799	20.035631	21.512554	19.841847	17.928285	32.380888
17.500286	20.056617	10.88532	20.146982	20.289726	28.197831	20.583304	16.137082	18.199099	18.016173	19.039433	17.25488	16.113268	30.471625
12.587053	16.152393	6.175249	15.276832	16.421775	23.340968	15.703194	11.026582	13.085362	13.047237	14.358409	12.770082	10.666082	25.55102
12.58546	23.251514	18.436176	10.353371	7.4578013	16.774311	10.886175	14.807214	12.599421	12.054821	12.142479	11.393116	13.576671	20.736005
8.1865744	19.259177	18.190168	10.818175	5.862508	15.716797	8.501788	12.334237	9.7578276	10.034466	8.6429162	8.4070744	11.586777	18.519933
8.1541401	18.987362	17.876806	11.588568	6.3802038	16.506959	8.8636561	12.301683	9.7767684	10.269981	8.7137822	8.5027584	11.478301	19.275941
5.2417554	15.142084	16.509179	12.638232	8.9062338	16.007002	8.3186057	9.3691729	7.7991794	8.9745473	6.0029993	5.5870296	9.9049987	17.249786
7.5432089	10.412392	13.46938	15.900343	13.711564	21.415548	13.757631	8.8394231	10.762862	12.800254	10.143964	8.5942364	10.442289	22.2711
12.481987	10.892103	21.876385	23.140892	21.297582	24.518273	19.231287	14.935039	17.247585	16.352569	15.314046	14.034988	18.961893	21.09649
13.249091	10.324413	21.95934	23.82451	22.047952	25.899037	20.459462	15.487924	18.220911	17.482817	16.39251	14.879291	19.618354	22.687827
8.1357237	9.8286266	11.593714	15.197661	14.393992	20.977076	13.721676	7.7863599	10.348198	12.684893	10.369667	8.9063404	9.2370666	21.947162
0	11.328102	13.12944	12.63	11.383189	17.433694	9.5175837	6.5566302	7.4481676	6.7774995	6.6136223	4.99949	8.5724792	17.711858
11.328102	0	15.005469	21.601412	21.69997	25.037656	18.763195	11.214415	15.243841	15.104496	14.844928	13.484717	15.100136	22.760448
13.12944	15.005469	0	16.169462	18.807387	21.084276	14.5437	8.9897831	11.449026	11.664249	13.308576	12.487822	8.8441054	22.259647
12.63	21.601412	16.169462	0	7.6430949	13.231931	9.917777	12.757355	10.860005	12.679621	11.863006	11.592178	10.162573	18.532895
11.383189	21.69997	18.807387	7.6430949	0	15.915015	10.380241	13.986436	11.627252	13.428034	11.188342	10.639685	12.20059	20.633848
17.433694	25.037656	21.084276	13.231931	15.915015	0	9.1860057	15.416021	11.798733	14.435096	12.31307	14.315244	13.428652	8.1714013
9.5175837	18.763195	14.5437	9.917777	10.380241	9.1860057	0	8.5998721	4.0214923	6.7229086	4.629946	6.5751274	6.5849525	12.181745
6.5566302	11.214415	8.9897831	12.757355	13.986436	15.416021	8.5998721	0	4.7915551	6.8334837	5.5276939	4.7140747	4.524732	15.594066
7.4481676	15.243841	11.449026	10.860005	11.627252	11.798733	4.0214923	4.7915551	0	5.6956562	2.7740224	4.2828145	3.5187214	13.378576
6.7774995	15.104496	11.664249	12.679621	13.428034	14.435096	6.7229086	6.8334837	5.6956562	0	6.2536789	6.4607275	7.4087178	14.571898
6.6136223	14.844928	13.308576	11.863006	11.188342	12.31307	4.629946	5.5276939	2.7740224	6.2536789	0	2.7515268	5.8778738	13.233817
4.99949	13.484717	12.487822	11.592178	10.639685	14.315244	6.5751274	4.7140747	4.2828145	6.4607275	2.7515268	0	6.1474141	15.213856
8.5724792	15.100136	8.8441054	10.162573	12.20059	13.428652	6.5849525	4.524732	3.5187214	7.4087178	5.8778738	6.1474141	0	15.722745
17.711858	22.760448	22.259647	18.532895	20.633848	8.1714013	12.181745	15.594066	13.378576	14.571898	13.233817	15.213856	15.722745	0

of the nasal cavity. More evident changes fall in the Mesolithic-Neolithic transition and appear to be particularly concentrated in particular in orbital and bregmatic areas.

Genetic studies of variability are still ongoing, but early results seem to confirm a general diversification in terms of mitochondrial DNA of the eastern Alpine populations, with a common genetic basis that originated in the Balkans during the Paleolithic and biological differentiation in conjunction with the arrival of farmers from the Middle East between 6,000 and 5,000 BP (Barbujani *et al.*, 2008), these results coincide with the morphological variability observed during this research. However, given the high rate of variability, we are aware that you can get a statistically representative picture of the population only with a large number of specimens. Unfortunately we did not have the possibility to study the morphometry of specimens other then those from the museum's collection in this occasion. Therefore, a possible development of the research consists in the analysis of more skeletal series from the Trentino-Alto Adige, examining in depth changes observed in the cranial vault and the mechanisms for making them. The CT (Computed Tomography) may allow an assessment of the internal bone structures in order to understand whether the alterations of VZa are attributable to the same traumatic event, while the FEA (Finite Element Analysis) would add information about the biomechanics of the jaw. In addition, a direct comparison between Vel.R and other individuals from the necropolis of La Vela would hypothesize ritual practices, surgical or any episodes of interpersonal violence related to head injuries.

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