Aurignacian osseous points from the Potočka zijalka cave (Slovenia). Interpreting the new results of a morphometric statistical analysis

Orinjasjenske koščene konice iz Potočke zijalke. Razlaga novih rezultatov morfometrične statistične analize

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Izvleček

Zbirka 134 orinjasjenskih koščenih konic z masivno bazo iz Potočke zijalke je po 90 letih od odkritja še vedno največja takšna zbirka v Evropi. Konice, ki so bile večkrat predmet različnih raziskav, so bile najdene v dveh plasteh na dveh lokacijah z različnim bivalnim in sedimentacijskim mikrookoljem. Glede na vzdolžni presek konic sta z velikim številom primerkov v obeh plasteh in na obeh lokacijah zastopana dva različna tipa konic: ploščat in vretenast, ki se razlikujeta tudi po tehničnih lastnostih. S po enim primerkom je zastopanih nekaj monotipov, med katerimi je tudi t. i. *tip mladečke konice*. Sto sedemnajst konic obeh glavnih tipov je tokrat prvič sistematično analiziranih z uporabo standardnih parametričnih in neparametričnih statističnih postopkov na podlagi kombinacij 20 znakov: 9 metričnih in 11 opisnih. Glede na izsledke analiz je predlagana vrsta novosti o domnevnih razvojno-tehničnih izboljšavah konic, načinu nasaditve, popravilu poškodb, izdelavi nastavkov za večje konice in pomenu zarez na robovih nekaterih konic. Avtorja ugotavljata, da gre pri tipu vretenastih konic Potočke zijalke za tehnično izpopolnjeno obliko konice z masivno bazo, ki si upravičeno zasluži naziv *konica Potočka zijalka* ali *olševska konica*.
Ključne besede: Slovenija; Potočka zijalka; orinjasjen; koščene konice; morfometrična analiza (ANOVA); tipologija

Abstract

After ninety years since its discovery, the 134 massive-based Aurignacian osseous points from the cave site of Potočka zijalka still represent the largest collection of its kind in Europe and the subject of numerous and varied studies. They were found in two layers in two different areas of the cave with different habitation and sedimentation microenvironments. Most are either flat or spindle-shaped with regards to their longitudinal cross section or side contour, each with its own set of technical properties and present at both areas of the cave. There are also single examples of several monotypes, including a *Mladeč type point*. Of the two main types, 117 points are systematically analysed here for the first time using standard parametric and non-parametric statistical procedures based on a combination of twenty variables, nine of them metric and eleven descriptive. The results of the analysis have led to new observations concerning the presumed technical improvements of Aurignacian points, the way the points were hafted, repairs of damaged points, manufacture of blanks for large points and the significance of the cuts and incisions occurring on some of them. They have also shown the spindle-shaped points from Potočka zijalka as a technically accomplished shape of massive-based point meriting the name the *Potočka zijalka* or *Olševa point*.
Keywords: Slovenia; Potočka zijalka; Aurignacian; osseous points; morphometric analysis (ANOVA); typology

Dedicated to the memory of Srečko and Mitja Brodar,
who left us a valuable collection of Palaeolithic finds from the Potočka zijalka cave.

1. INTRODUCTION

The cave of Potočka zijalka (hereinafter also P. z.) lies at 1650 m a.s.l. on the southern slope of Mt. Olševa (1849 m), in the eastern Karavanke Mountains. It ranks among the most important and best known Palaeolithic sites in Slovenia. Potočka zijalka was excavated in several campaigns that yielded the greatest collection of well-preserved Aurignacian bone points with a massive base in Europe: 1926–1928 (M. Brodar 1994), 1928–1935 (Brodar, Brodar 1983) and 1997–2000 (M. Brodar 2000; Pohar 2004; Pacher, Pohar, Rabeder 2004), while in 2012 a small part of the back dirt left behind by S. Brodar was re-examined (Odar 2014). The bulk, i.e. 127 points was found during the 1928–1935 excavations led by S. Brodar. Comparable numbers of Aurignacian points, but in a much poorer condition and made almost exclusively of antler, have been unearthed at Istállóskő in Hungary (~130 pieces as counted by I. and M. Turk, and related by Horusitzky), as well as Abri Blanchard des Roches (~154 pieces), La Ferrassie (~136 pieces) and Abri Castanet (~73 pieces) in France (Leroy-Prost 1979).

The P. z. collection currently comprises 135 points that include a single split-based example. M. Brodar analysed them in the most systematic and detailed manner (Brodar, Brodar 1983; M. Brodar 1985a; 1985b; 2009). They were also discussed from various aspects by a number of other authors (Bayer 1929; Albrecht, Hahn, Torke 1972; Hahn 1988; Turk 2002; 2005; 2014; Horusitzky 2006; Odar 2008, 2011; Pacher 2010; Verpoorte 2012; Jéquier 2016; Doyon 2017; 2019). Six of the points were directly dated using the AMS ^{14}C method (Rabeder, Pohar 2004; Moreau et al. 2015).

There is much scholarly interest for Aurignacian points of bone or antler. In the last decade, several articles have been published in various journals that mainly tackle questions related to the manufacture and use of the points, all more or less on the basis of experiments. Their results inasmuch as they pertain, directly or indirectly, to the P. z. collection are critically evaluated further down.

The numerous points from P. z. were unearthed in two archaeological levels in two different parts of the cave with different living conditions (Brodar, Brodar 1983). This, coupled the possibilities for a statistical stratification, make the sample of the points from P. z. very suitable for a comprehensive statistical analysis. We continued the analytical work that I. Turk began some years ago (Turk 2002; 2005; 2014) and systematically investigated the entire sample, interpreting it with the help of standard descriptive and analytical statistics. Until Turk, no other author attempted to statistically analyse all the points from P. z., after him, this was only performed by Doyon (2017; 2019).

2. METHOD

We used a sample of 117 points from P. z. to perform a new analysis based on nine quantitative (metric) and eleven qualitative (descriptive) variables or their combinations (*App. 2*) using the STATISTICA software. This sets it apart from the analytical approach of S. and M. Brodar (1983), as well as other authors who analyzed the collection of P. z. points in a different way and from various aspects.

The advantage of statistically analysing a large quantity of data is that it reveals characteristics otherwise not clearly perceptible. The analysis must be conducted on a large enough sample, the values of which are preferably normally distributed. The shape of distribution can roughly be gleaned from the frequency distribution histogram. Sample size and normal distribution of sample values are interconnected: the larger the sample, the more the values come closer to normal distribution (central limit theorem); hence the lower limit for the number of values in a sample.

All data were subjected to the Shapiro-Wilk W-test (hereinafter the SW W-test) to verify the degree of probability that the sample belongs to a population of normally distributed values. If the probability exceeds 5% ($p > 0.05$), the sample may belong to such a population, hence we can analyse it with parametric statistics based on the mean value. If the probability is below 5%, the sample does not belong to a population of normally distributed values and it is better to analyse it using non-parametric statistics based on the median value and ranks.

Parametric statistics have certain advantages over non-parametric. We used both, depending on the distribution of values and the instructions for using individual analytical statistical procedures.

The basis of our analytical work was the one-way analysis of variance (ANOVA) used to verify whether the means of selected populations differ from one another. The ANOVA demands a normal distribution of values. The SW W-test for all unaltered metric values on the points was negative

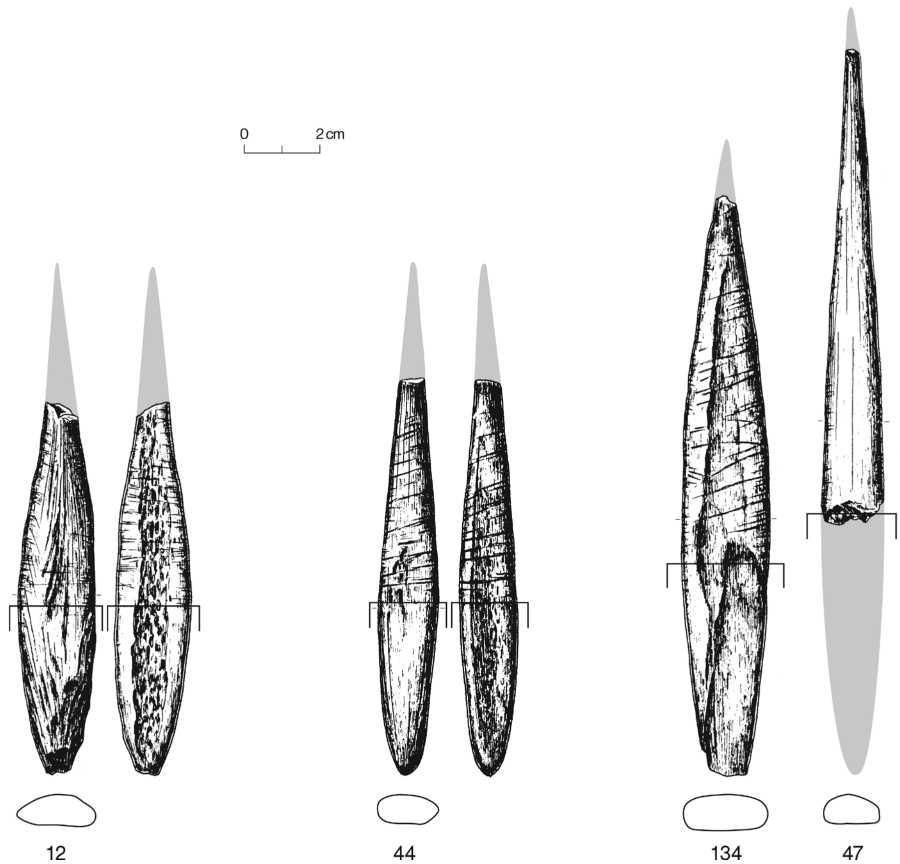


Fig. 2.1: Points Nos. 12, 44, 134 and 47 from P. z. (Potočka zijalka) with marked border between hafted and unhafted parts. The drawings of this and all other points are taken from S. and M. Brodar (1983, Pls. 6–22).
Sl. 2.1: Konice št. 12, 44, 134 in 47 iz P. z. (Potočke zijalke) z nakazano mejo med nasajenim in nenasajenim delom. Risbe konic so, enako kot v vseh naslednjih slikah, povzete po S. in M. Brodarju (1983, t. 6–22).

($p < 0.05$), which led us to use the square root of values to obtain a positive result ($p > 0.05$) for all the data altered in this manner except for the percentage of reconstruction, mass and cross section of the points (*App. 2*, last line). For the last three, we used non-parametric statistics instead, which are based on the median and ranks, as well as the use of the Kruskal-Wallis median test (KW-test).

The use of the ANOVA also demands homogeneity of variances. This was verified using the Levene's test, where a statistically significant result shows inhomogeneous variances. We also verified the correlation between the means and standard deviations of the factors that can create a substantial disruption and may influence the results of the analysis of variance.

In the analysis of variance, the measurable data (e.g. length, width, thickness, mass) represent dependent variables, while the data that can be manipulated or controlled (e.g. size, side contour of the point and so forth) are factors or independent variables. Factors can be fixed or random. The latter comprise all the factors whose categories are more or less randomly selected. For example, the 'small', 'medium-sized' and 'large' point categories in the *size* factor are randomly selected; someone else would likely select them differently. In contrast, the 'front' and 'back' categories in the *cave area* factor, as well as the 'yes' or 'no' in the *cuts and incisions* factor are fixed because no other selection is possible. The analysis of variance can also predict the situation created by random factors. A subjective factor selection does contribute to the variance and this contribution can be estimated if necessary.

In the analysis of variance, we can test every factor separately while controlling all others at the same time. This makes the ANOVA more statistically powerful than the t-test, which hmeans that less than the prescribed 30 values suffices

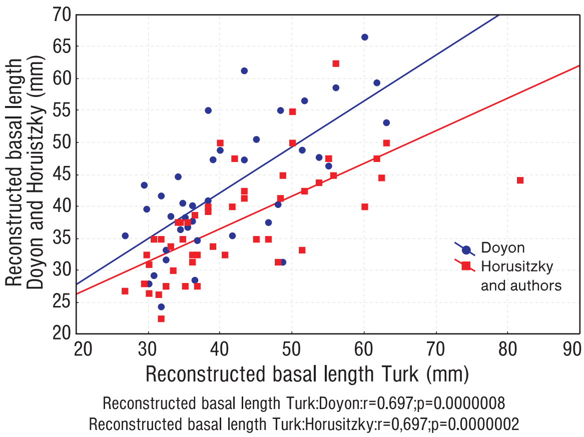


Fig. 2.2: Correlation between the arbitrarily delimited basal part of the points from P. z. as proposed by Doyon (2017), Horusitzky (2008) and the authors of this contribution. For data see *App. 1*.
Sl. 2.2: Povezanost različno arbitrarno zamejene baze konic iz P. z., kot jo predlagata Doyon (2017) in Horusitzky (2008), s predlagano zamejitvijo baze avtorjev članka. Za podatke glej *prilogo 1*.

to establish statistical reliability. This come very handy in stratified samples where the number of values per stratum decreases.[1]

The statistical analysis was performed under the assumption that a large part of the points were used as throwing or thrusting spears, possibly as arrowheads. M. Brodar (2009, 340) did not analyse in detail how the points were used, but did believe that roughly half of them were hafted. The P. z. collection only comprises nine points that survive complete and further three or four almost complete, while others are damaged to different degrees, which made it necessary to reconstruct their original lengths: total length,[2] length of the hafted (basal) part and that of the active (distal) part (*App. 2*). Both parts can include the medial section if present on the point at all. It is difficult to objectively separate the medial from the basal and distal parts. I. Turk (2002) dedicated a special study to the medial part. Our arbitrary distinction is based on the assumption that the hafted part covers 1/3 of the total length of the javelin-, lance- or arrowhead in optimally hafted points.[3] S. and M. Brodar suggested this for the hafted points from P. z. (1983, Pl. 15: 54; M. Brodar 2009, 340) and Horusitzky (2008) for the points from Dzérava skala. Horusitzky also developed a special procedure for reconstructing points presumably damaged through use. This rule represents one of the main premises of our analysis and is substantiated by:

– 1.) cuts on the edges and incisions[4] on the front and back that predominantly only occur on the upper two thirds of the points, i.e. the active distal part (Nos. 12, 30, 44, 64, 74, 109, 113, 124, 134),[5] while they are absent on the base (*Fig. 2.1:* 12,44,134);

– 2.) basal fragments usually without cuts and incisions (Nos. 94, 108, 112, 113, 114, 121, 123, 126–128, 132, 133) (*Fig. 3.4*);

– 3.) distal fragments with cuts along the total length (Nos. 8, 66, 91, 136) (*Fig. 2.1*: 47);

– 4.) especially one point broken in two, i.e. a basal (No. 125) and a distal fragment (No. 86) (*Fig. 3.4:* 86 and 125).

The last point could only have broken at the spot where the point jutted out of the shaft (hereinafter shaft-point junction) when it hit a hard obstacle. It could not have been broken in a post-sedimentary process because the damage (breakage) of the apex is such as typically occurs when a point hits a hard obstacle (see Horusitzky 2008). In addition, the two fragments were recovered far apart from one another (Brodar, Brodar 1983, 103; Figs. 48, 49), with rounded fracture edges on the basal and sharp ones on the distal fragment. It is, of course, not

[1] The statistical stratification of a sample is meant here, with large, medium-sized and small points, for example, representing sample strata.

[2] The 104 reconstructed lengths and all unreconstructed measurements have been taken from the unpublished list compiled by M. Brodar (archives of the Inštitut za arheologijo ZRC SAZU; Ljubljana [Institute of Archaeology ZRC SAZU]). S. and M. Brodar (1983, 124) initially estimated the length of 101 points. Later, M. Brodar (1985a; 1985b) limited the number of points with a reconstructed length to 83. He probably left out the reconstructions he deemed less credible. We added 13 reconstructions of total length and all reconstructed lengths of the distal and basal parts to Brodar's list. The missing parts were reconstructed arbitrarily based on the known shape of complete points.

[3] In his publications, I. Turk (2002; 2005; 2014) determined the distal part using a different criterion, hence his reconstructed measures differ slightly from those given here, but this does not significantly influence the results of the analysis. The parts of the point as distinguished here (total, distal, basal length) are automatically in perfect correlation (see *Fig. 5.1*). This means that the statistical analytical procedures that include these parts provide similar or redundant results; it is therefore enough to only include one part of the point in the analysis.

[4] For terminology see Chapter 9.

[5] The point numbers refer to those used for the drawings published by S. and M. Brodar (1983).

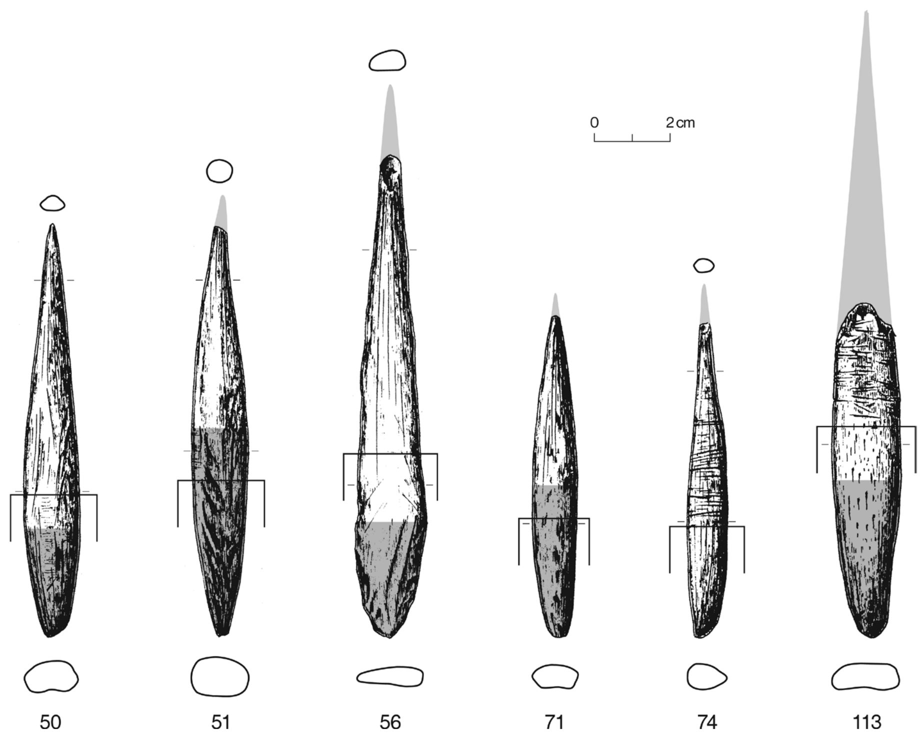


Fig. 2.3: Points Nos. 50, 51, 56, 71 and 113 from P. z. with hafted parts according to Doyon (2017, Annexe 2: 3066, 3067, 3070, 3076, 3090) (*App. 3*) and according to a 1 : 2 ratio between basal and distal parts. The basal parts according to Doyon are shaded. For the potential length of the hafted base see point No. 74 with incisions, which is the same size as No. 71.
Sl. 2.3: Konice P. z. št. 50, 51, 56, 71 in 113: domnevna nasadišča po Doyonu (2017, Annexe 2: 3066, 3067, 3070, 3076, 3090) (*pril. 3*) in po razmerju 1 : 2 med bazo in distalnim delom. Doyonove baze so v rastru. Za potencialno dolžino nasajene baze glej konico št. 74 z zarezami, ki je velika kot konica št. 71.

possible to completely rule out post-sedimentary breakage, but such an interpretation involves many more coincidental events connected with the action of humans and natural forces, which erode its credibility as opposed to the simple explanation of damage through use (see below).

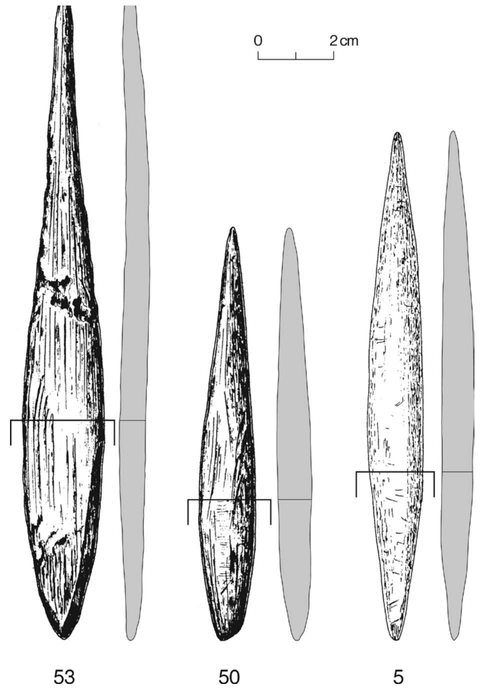
It is possible to distinguish basal and distal parts in a different arbitrary manner. According to Doyon, the base of a point begins or ends at maximum width (Doyon, Knecht 2014; Doyon 2017; 2019). For the points from Dzérava skala, Horusitzky (2008) determined that the length measured 2.5-times the width.[6] When applying these rules to the points from P. z., there are certain deviations with regards to our determination of the basal part, there are illogical solutions (*Figs. 2.2; 2.3*), but also cases where the base is of the same length as the one we proposed.

[6] For the wide points with a predominantly split base, the base : distal part ratio was exceptionally 1 : 2. This ratio changed for the narrow points with a massive base. Deviation occur as shown for select points from P. z. in *Fig. 2.3*.

3. RESEARCH GOALS AND THEORETICAL PREMISES

The main aim of our analysis was to define and explain the characteristics of the sample related to the manufacture, use, maintenance and possible storage of osseous points. The focus was on the factors influencing the development of the points as a hunting weapon through the several thousand year long period of the Aurignacian. Key in this evolution was strength (reliability) and penetrating effect (efficiency) of the points as generally accepted qualities (Doyon, Knecht 2014). Both are closely connected with the shape of the points that is the basis for typology (Horusitzky 2004; 2006; Turk 2005). Given the side contour (profile) of the points from P. z., we arbitrarily distinguish between flat and spindle-shaped (see Turk 2005). Flat points have parallel front and back planes along a considerable stretch of their length in the medial part, while front and back planes of spindle-shaped points are conspicuously thickened roughly at one third of their total length (*Fig. 3.1*).

3.1.



3.2.

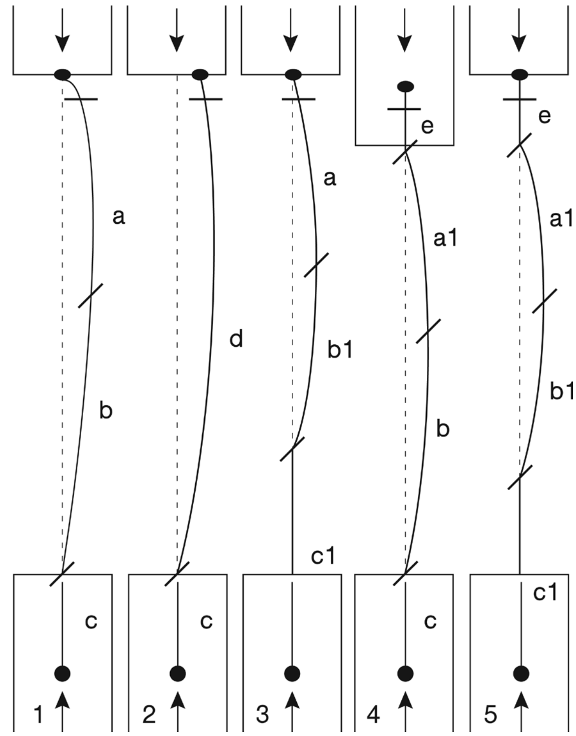


Fig. 3.1: Examples of flat (No. 53) and spindle-shaped (No. 50) points, as well as the only biconical spindle-shaped point (No. 5) from P. z. with marked base as presumed in this contribution. The maximum thickness of No. 50 is 1 cm above the end of the presumed base.
Sl. 3.1: Primerek ploščate (št. 53) in vretenaste konice (št. 50) ter edine vretenaste bikonične konice (št. 5) iz P. z. z označenim domnevno nasajenim delom (bazo). Pri št. 50 je največja debelina 1 cm nad začetkom domnevne baze.

Fig. 3.2: Simplified display of the possible buckling (Nos. 1–5) of the osseous points when encountering a hard obstacle. The spots marked are where the points break due to buckling (short oblique line), the inevitable damage to the apex (short horizontal line) and potential fragments (letters). A single (No. 2), double (Nos. 1, 3) and triple break (Nos. 4, 5) is possible. The P. z. collection includes the following fragments: **e**: 4 fragments (*Fig. 3.3:* e.g. No. 1, 2); **a**?: 1 fragment (Brodar, Brodar 1983, Pl. 6: 119); **b** or **b1**: 3 fragments (Brodar, Brodar 1983, e.g. Pl. 22: 21); **a1**+ **b** and **a1** + **b1**: 4 fragments (*Fig. 3.5:* e.g. No. 104); **d**: 11 fragments (*Fig. 3.5:* e.g. No. 106); **a1** + **b** + **c** and **a1** + **b1**+ **c1**: 22 fragments (*Fig. 3.3:* e.g. No. 3); **b** + **c** and **b1** + **c1**: 6 fragments (*Fig. 3.4*: e.g. No. 103); **c1**: 2–5 fragments (*Fig. 2.3:* e.g. No. 113) and **c**: 11 fragments (*Fig. 3.4:* e.g. No. 112).
Sl. 3.2: Poenostavljen prikaz možnih uklonov (št. 1–5) organskih konic kopja, ko te naletijo na trdo oviro. Označena so mesta, kjer se konice zaradi uklona lahko prelomijo (poševna črtica), neizbežna poškodba apeksa (vodoravna črtica) in potencialni odlomki (črke). Možen je enojni (št. 2), dvojni (št. 1, 3) in trojni prelom (št. 4, 5). V zbirki konic P. z. so zastopani naslednji odlomki prikaza: **e**: 4 primerki (*sl. 3.3:* npr. št. I, II); **a**?: 1 primerek (Brodar, Brodar 1983, t. 6: 119); **b** ali **b1**: 3 primerki (Brodar, Brodar 1983, npr. t. 22: 21); **a1** + **b** in **a1** + **b1**: 4 primerki (*sl. 3.5:* npr. št. 104); **d**: 11 primerkov (*sl. 3.5:* npr. št. 106); **a1** + **b** + **c** in **a1** + **b1** + **c1**: 22 primerkov (*sl. 3.3:* npr. št. 3); **b** + **c** in **b1** + **c1**: 6 primerkov (*sl. 3.4:* npr. št. 103); **c1**: 2–5 primerkov (*sl. 2.3:* npr. št. 113) in **c**: 11 primerkov (*sl. 3.4:* npr. št. 112).

This side contour criterion is simple and reliable in most cases. Insofar as we know, it has not yet been used before because the focus was rather on the shape of the points in front view (Albrecht, Hahn, Torke 1972; Hahn 1988; Doyon 2017; 2019). Apart from overall shape (geometry), efficiency of a point is also determined by its size, which needs to be suited to the size of the prey, as well as to either an offensive or a defensive role. As opposed to the lithic points, those of bone and antler were better at penetrating deeper, reaching the internal organs and immediately immobilising the prey; this eliminated the need for tracking down the wounded animal.

A feature common to all points from different sites is a more or less damaged condition. We presume that most of the damage (breakage) at P. z. occurred due to buckling (*Fig. 3.3*) and

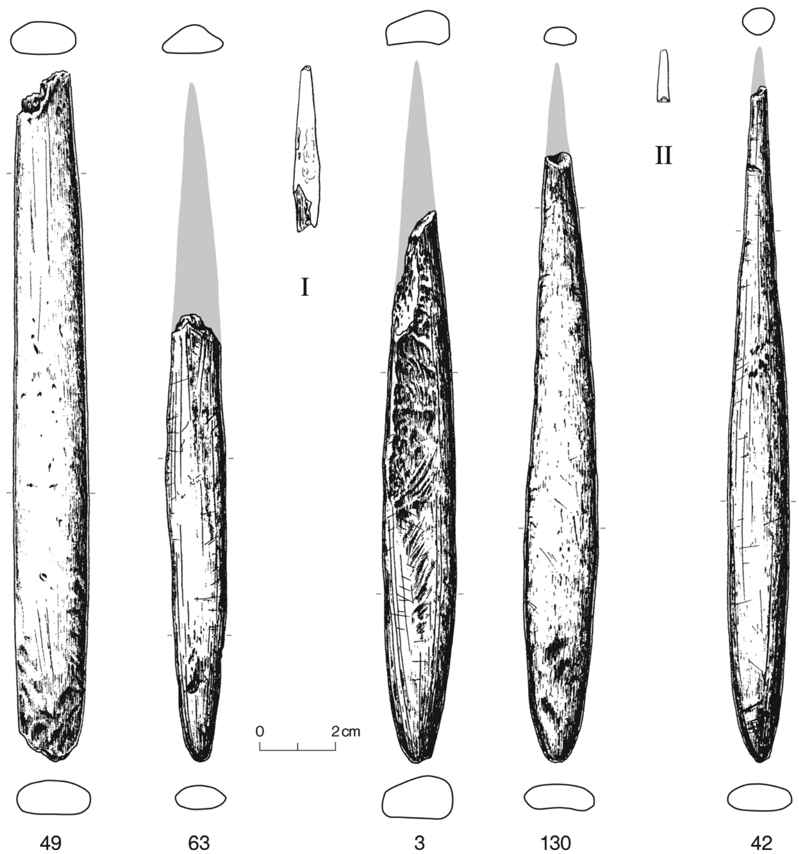


Fig. 3.3: Examples of apical and substantial distal damage on the points from P. z. The apical fragments are taken from Odar 2014.
Sl. 3.3: Primeri apikalnih in večjih terminalnih poškodb na konicah P. z. (Apikalni odlomki so povzeti po Odar 2014.).

flexion during use (Horusitzky 2007) and that the damage was repaired. The apical and distal parts were most susceptible to damage (*Fig. 3.2*), as corroborated by experiments (Doyon, Knecht 2014; Odar 2008). There are even individual apical and distal fragments, from P. z. and other sites (Odar 2014; Leroy-Prost 1979, Figs. 38, 52, 92; Istállóskő, numerous unpublished examples). It is also possible to connect the frequent deviation in maximum thickness distally from the beginning of the presumed current base, which took up 1/3 of the length of the undamaged point, with presumed repairs of damaged distal parts (see *Figs. 10.5* and *10.6*). This resulted in a shortened total length of the point and its base (*contra* Doyon 2017, who believes that repairs to the distal part did not result in a shorter base), while retaining the 1 : 2 ratio between base and distal part.

Points also broke at the shaft-point junction (Brodar, Brodar 1983; M. Brodar 2009, 340; Horusitzky 2008). Evidence of this is the basal and long distal fragments of massive-based points from P. z. and La Ferrassie (Brodar, Brodar 1983, Pls. 6–10, 21; Odar 2014; Leroy-Prost 1979, Fig. 52: 11) (*Figs. 3.4* and *3.5*). Such breakage cannot be replicated in experiments not using live targets and the projectiles not hitting a rock or a tree if missing the target. Experiments show that the heads of arrows and other projectiles most commonly sustain apical and minor distal damage (Odar 2008; Doyon, Knecht 2014); for the projectiles with such damage, it would have been much easier to repair than to make new ones (Hahn 1974; 1988; Turk 2002; Horusitzky 2008; Doyon 2013; Doyon, Knecht 2014). It was also possible to repair long distal fragments by making a new base.

As for post-sedimentary damage, we should make certain general remarks. If most fragments occurred through post-sedimentary processes, we would expect more fragments to fit into whole points that only one. Moreover, it does not seem plausible for people to have left complete points lying on the ground where some broke apart and

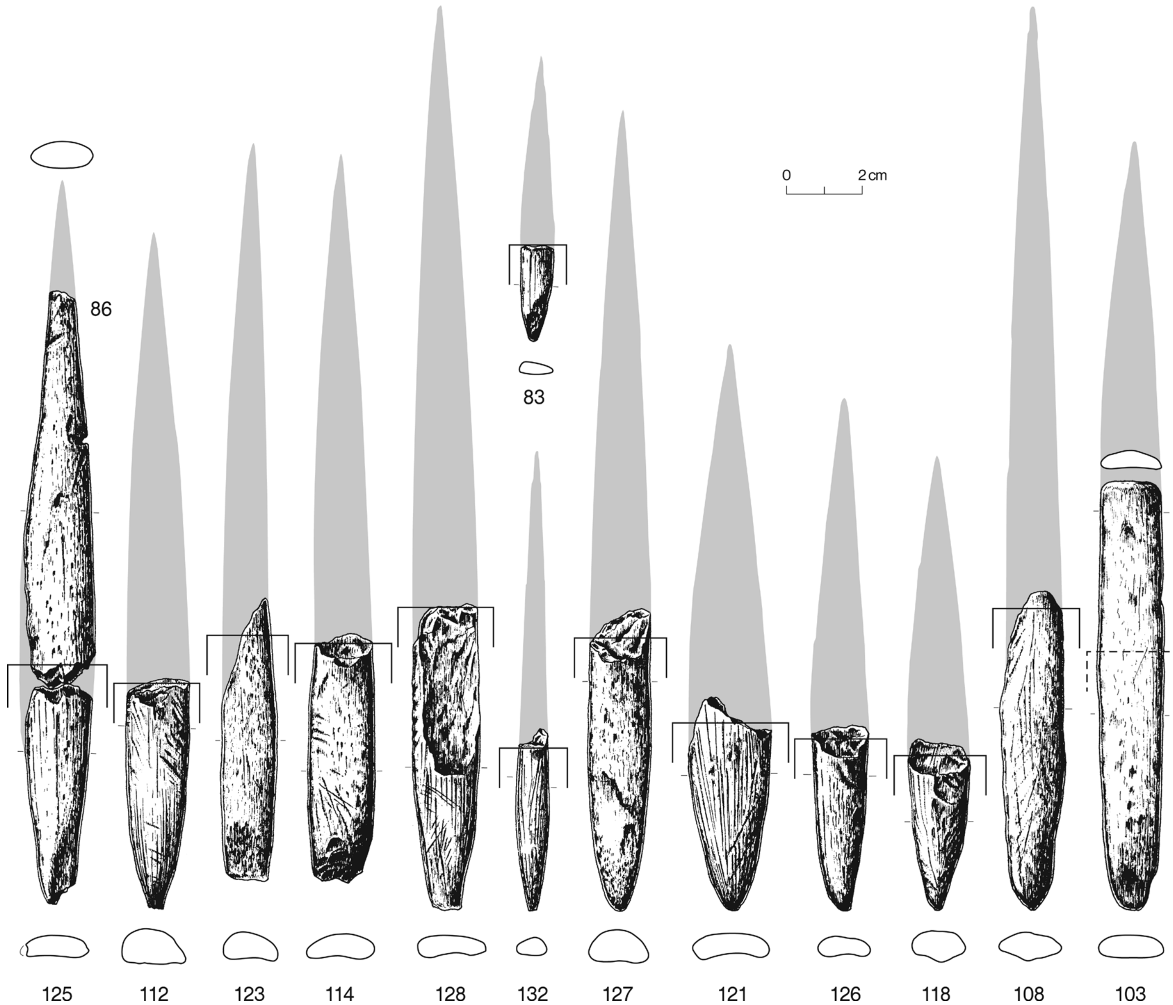


Fig. 3.4: Basal fragments of the points from P. z. and their presumed original length.
Sl. 3.4: Bazalni odlomki konic P. z. in njihove domnevne prvotne dolžine.

individual fragments travelled far apart from one another not to be found by archaeologists because of a limited scope of excavation. It is difficult to imagine that some of the larger points could have broken either on the ground or in the sediment. Finally, experiment results and a recurring pattern of basal and distal fragments does not allow us to exclude the possibility that different damage occurred through use and that people repaired the damaged points.

Numerous similar distal and basal fragments show that firmly hafted points tended to break at the shaft-point junction. It is therefore necessary to strengthen this part and transfer the damage to the shaft which was easier to repair than the point. This could be achieved by widening and/or thickening the body of the point without reducing its penetrating effect.

Given the above, we may posit the following more or less parallel tendencies in the evolution of points through use:

– 1.) Points became thicker and narrower, hence more durable and penetrating.

– 2.) Points became wider and thinner, hence more penetrating and less durable.

– 3.) Points became wider and thicker, hence more durable and less penetrating.

The evolutionary tendencies that eventually led to rod-shaped points are verifiable with stratigraphy, less with direct dating as the ^{14}C dates have an unsuitable resolution. Development was the result of the experience that one or several generations gained from using the points for hunting or other purposes. We may surmise that old and new improved shapes were in use at the same time, with the new shapes gradually ousting the old ones,

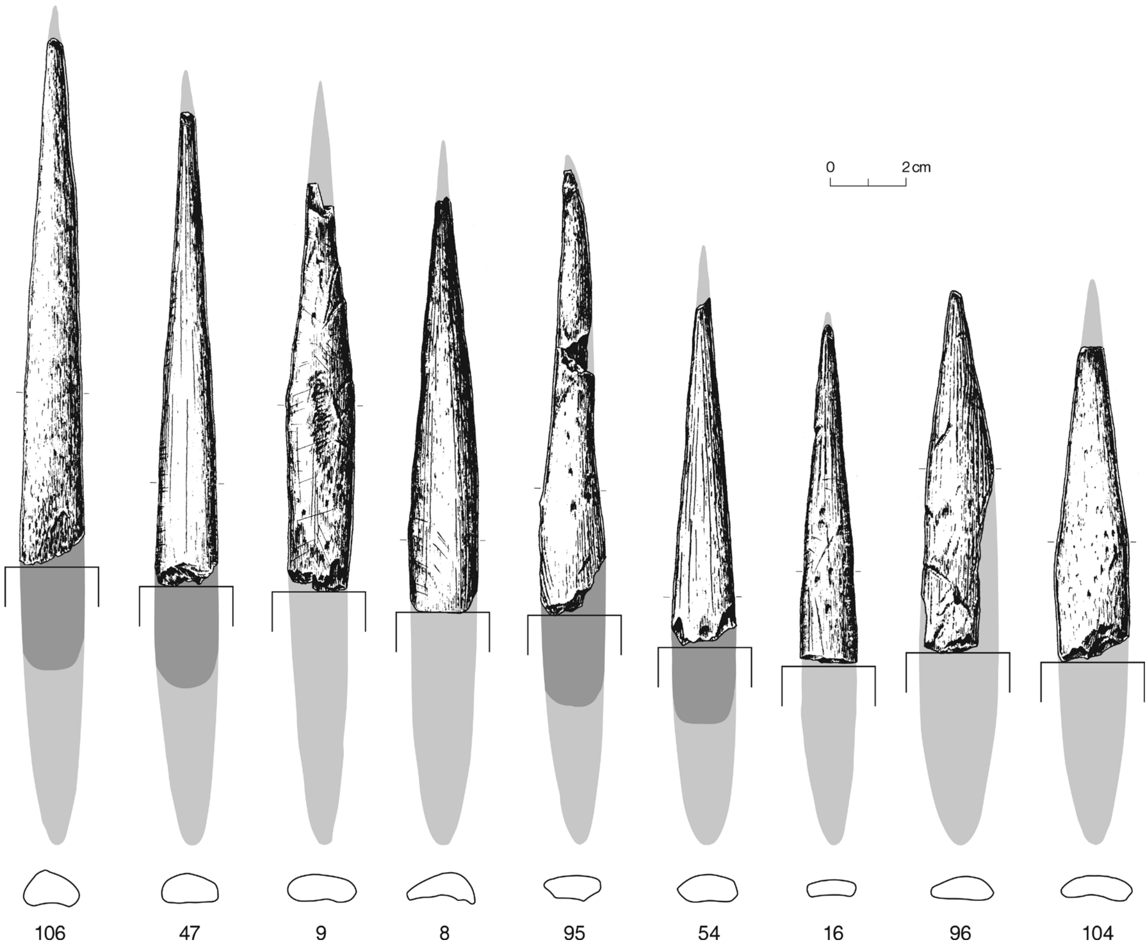


Fig. 3.5: Distal fragments of the points from P. z. and their presumed original length. The split-based variant is shaded.
Sl. 3.5: Terminalni odlomki konic P. z. in njihove domnevne prvotne dolžine. Varianta z razcepljeno bazo je osenčena.

as is generally the rule in introducing novelties. It should be noted that the points have not been analysed with this model of development in mind, either in Slovenia or elsewhere.

4. DESCRIPTIVE STATISTIC OF POINTS

The standard descriptive statistics of the principal measurements are given at the bottom of *App. 2* and in *Fig. 4.1*. The reconstructed lengths vary between 0 and 68% of the total length. The median is 13%. The interquartile range of the reconstructed lengths is 6–34%.

Half of all points have a reconstructed length that exceeds 132 mm and a preserved length that exceeds 99 mm. The interquartile ranges are 102–165 mm and 81–124 mm, respectively. The maximum reconstructed length measures 245 mm, the minimum 40 mm. Half of all points have a reconstructed distal part that exceeds 88 mm and an interquartile range of 68–110 mm, which corresponds with both the preserved (84–139 mm) and the reconstructed lengths (90–150 mm) of twelve distal fragments with a predominantly missing apex. The maximum reconstructed length of the distal part is 163 mm, the minimum 27 mm. Half of all points have a reconstructed base that exceeds 44 mm and an interquartile range of 34–55 mm. The maximum reconstructed length of the base is 82 mm, the minimum 13 mm. Nine basal fragments that presumably broke at the shaft-point junction are 43–80 mm long with the interquartile range of 57–75 mm.

Width and thickness are the two measures that most objectively represent the actual measures of

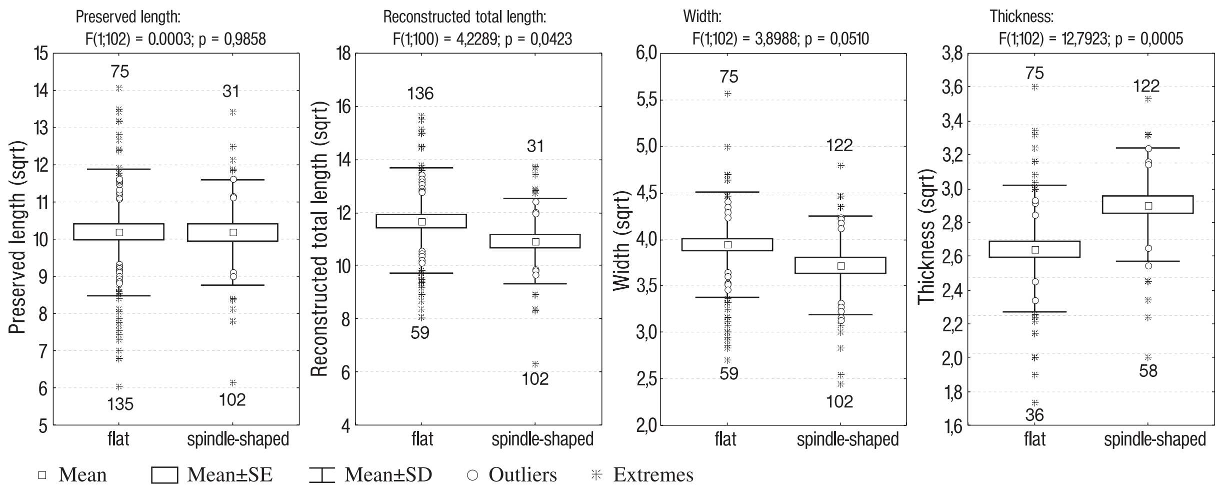


Fig. 4.1: The mean, standard error (SE), standard deviation (SD), outliers and extremes, as well as the result of the F-test of the main measures of the points from P. z. based on the proposed typology. All measures are transformed by square root extraction. The points with extreme measures are marked with their inventory numbers.
Sl. 4.1: Srednja vrednost (mean), standardna napaka (SE), standardno odstopanje (SD), "posebneži" (outliers) in "skrajneži" (extremes) ter rezultat F-testa glavnih mer vzorca konic iz P. z. glede na predlagano tipologijo. Vse mere so spremenjene s korenjenjem. Navedene so inventarne številke konic z ekstremnimi merami.

the points. Half of all points are wider than 15.2 mm and thicker than 8 mm. The interquartile range is at the width of 12.0–17.8 mm and the thickness of 6–9 mm. The maximum width is 31 mm, the minimum 6 mm. The maximum thickness is 13 mm, the minimum 3 mm. The thickness measures show that only a small part of the points could have been made of antler, which is characterised by a cortex that is relatively thin in comparison with the long bone cortex of cave bears and large ungulates (see also Pacher 2010).

The P. z. sample includes some points that stand out from the average metric values. They are rare, but not exceptional considering the larger unknown population of points represented by a small sample from P. z. The greatest preserved length, as well as greatest reconstructed total and distal lengths are recorded on the spindle-shaped point No. 31 (180, 188 and 125 mm) and the flat point No. 75 (198, 230 and 153 mm). The front shape of the latter closely corresponds with that of most other points from P. z. (Turk 2002).[7] No. 75 also stands out in a hole in its base (see M. Brodar 2009; Horusitzky 2008). The flat point No. 136 has the greatest reconstructed length (245 mm), which is the maximum of bone point lengths in general. The same holds true of the point No. 49, which we have not reconstructed.[8] At the other end of the scale, with the lowest preserved length, as well as reconstructed total and distal lengths, are the spindle-shaped point No. 102 (38, 40 and 27 mm) and the flat point No. 59 (46, 65 and 43 mm); the former also stands apart in its split base.

5. SIZE OF POINTS

The points from P. z. are divided into three size classes on the basis of the length of the distal part, i.e. their active part:

– 1.) small, 27 mm < 65 mm;
– 2.) medium-sized, 65–95 mm;
– 3.) large, > 95 mm.

The 10 and 90 percentiles, which cover 80% of all lengths, have a range of 43–65 mm for 1.), 69– 92 mm for 2.) and 97–150 mm for 3.). Apart from the shape of the passive base, it is the shape and length of the active distal part that is of importance for the study of points. The distal parts of the complete points measure 53, 57, 66, 68,

[7] Formally, point No. 75 stands between the spindle-shaped and flat type (see Turk 2005; 2014).

[8] Assuming that most points from P. z. are made of cave bear bones, it is not certain whether this artefact is really a point. Given the subparallel edges along the entire length, it would have been unlikely for the artefact to terminate in a suitably sharp tip as the long bones of cave bears could only produce up to 230 mm long points.

73, 75, 90 and 116 mm in length (*App. 2*). The maximum preserved length of the points Nos. 42 and 75 shows that the distal part may even have exceeded 120 mm. Considering the distal fragments Nos. 66, 106, 136 and the premise that points broke at the shaft-point junction, the distal part of the points from P. z. was 140–160 mm long.[9] This length enabled the hunter to mortally wound even a large prey. We posit that the length of the distal part was adapted to the size of the prey, as well as to the offensive or defensive use. Offensive points had to be as long as possible. The length could then decrease due to repairs of damage sustained during use. The repaired points could still be used for hunting smaller animals, for defensive or other purposes (Owen 2013). According to M. Brodar (2009), some points were not hafted at all. A number of authors have drawn attention to the need for distinguishing between the osseous points used as arrowheads, lanceheads, javelinheads or daggers (Vértes 1955; Brodar, Brodar 1983; Horusitzky 2004). The manner of use and the prey determined the size of the points without excessive deviations, such as characterise the analysed P. z. sample (*App. 2*).

The question connected with the preserved and reconstructed lengths is why there are so many different lengths that gradually increase from small to large (*Fig. 5.1*). In hunting weapons, it would not be reasonable to expect the size of the points to be coincidental, i.e. largely dependent on the differing sizes of the natural bone fragments. The numerous intermediate sizes, between large and small, may have occurred as a consequence of repairing large and medium-sized points. Such repaired examples may be seen in the points Nos. 12, 29, 80, 76, 82, 101, 104 and 122 that have a disproportionately great width and thickness in comparison with their length (*Fig. 5.2*) and a shape that stands apart considerably from the ‘standard’ point No. 75 (Turk 2002, Fig. 3: 12,80).

The ANOVA can help us in answering such questions. It could only be used for the width and thickness of the points from P. z. where the variance is homogeneous ($p > 0.05$) and there is no correlation between the factors, while the distribution is normal. Both measures show significant differences between size classes ($p = 0.000$). The width increases more substantially from small to medium-sized (average 5 mm, 33%) than from medium to large points (average 3 mm, 17%). The thickness increases substantially from small to medium-sized (average 2.5 mm, 32%) and hardly at all from medium-sized to large points (average 0.5 mm, 6%) (*Fig. 5.3*). This is also clearly visible from the median value and the interquartile range (KW $p < 0.001$). The almost identical thickness of the medium-sized and large points, and the relatively small decrease in width between large and medium-sized points may be the consequence of repairs of large examples. It is less likely that

[9] Under the same premise, we get a 150–160 mm long distal part for the basal fragments Nos. 108, 128 and 129. A very long distal part can also be expected for the basal-medial fragments Nos. 49 and 103.

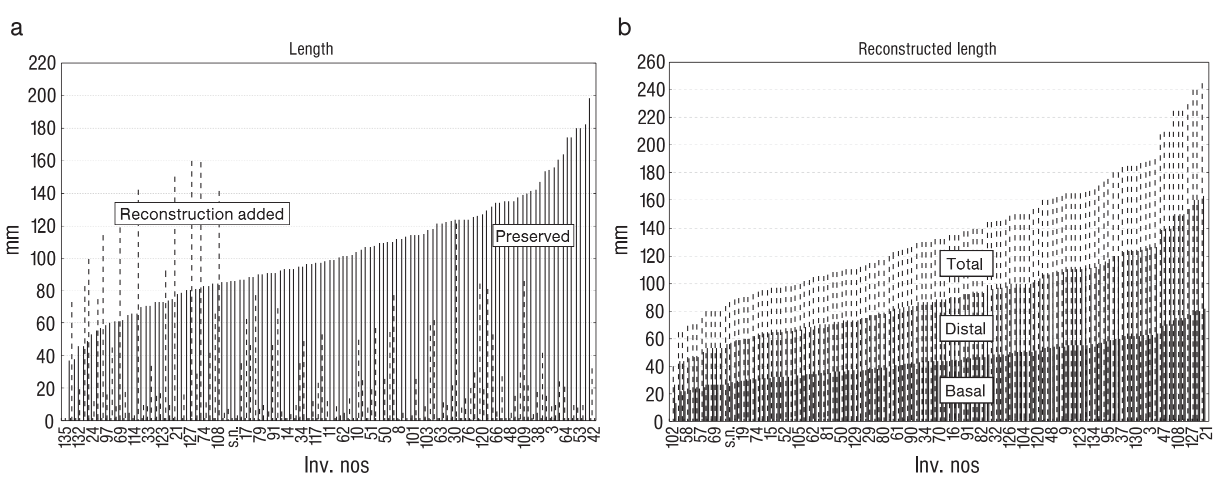
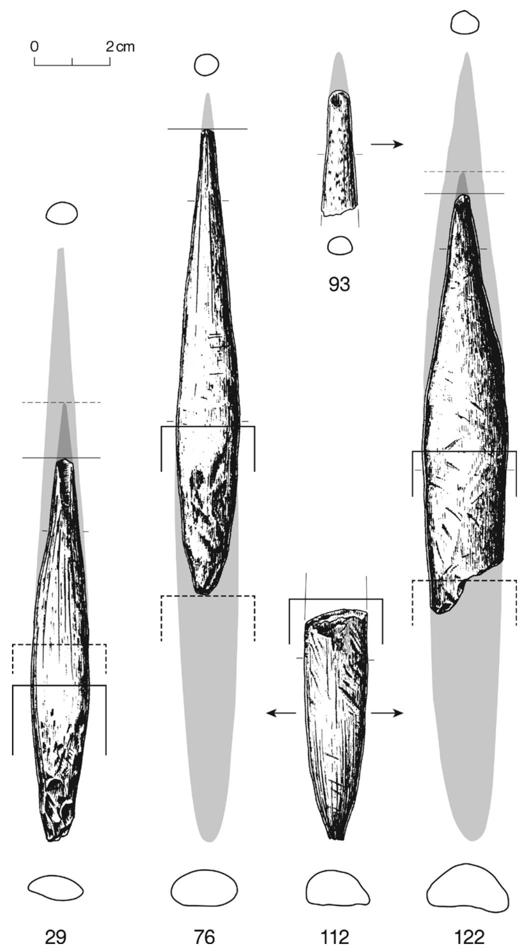


Fig. 5.1: Preserved length (unbroken line) and the length of the reconstructed part (broken line) (**a**), as well as the reconstructed length of the points from P. z. and their parts (**b**).
Sl. 5.1: Ohranjena dolžina posamezne konice (polna črta) in dolžina (prekinjena črta) rekonstruiranega dela (**a**). Rekonstruirane dolžine konic iz P. z. in njihovih delov (**b**).

5.2.



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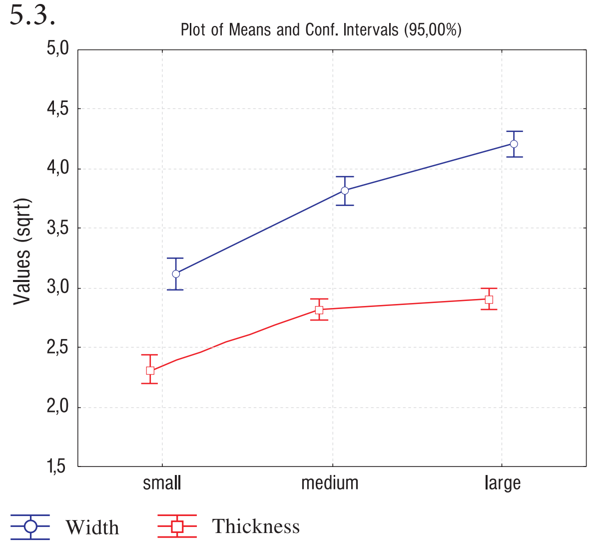


Fig. 5.2: Presumably repaired points from P. z. (Nos. 29, 76 and 122) and their original size. A typical apical (No. 93) and basal fragment is also shown (No. 112).
Sl. 5.2: Domnevno popravljene konice iz P. z. (št. 29, 76 in 122) in njihova prvotna velikost. Prikazana sta tudi značilen terminalni (št. 93) in bazalni odlomek (št. 112).

Fig. 5.3: Result of the analysis of variance (One-way ANOVA, $p < 0.001$) pertaining to the width and thickness of the points from P. z. in relation to their size class (total n = 114; partial n = 26 – small, 41 – medium-sized, 47 – large).
Sl. 5.3: Rezultat analize variance (One-way ANOVA, $p < 0{,}001$) širine in debeline konic glede na velikost konic (skupni n = 114; delni n = 26 – majhna, 41 – srednja, 47 – velika).

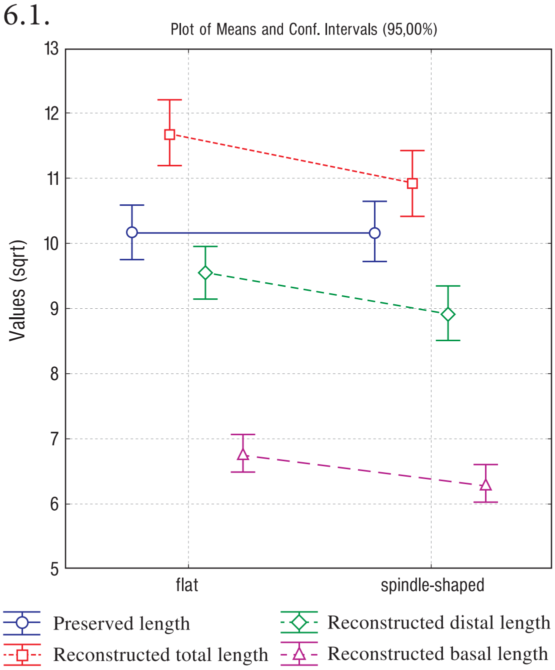
medium-sized and large points were produced from equally thick blanks and much smaller blanks were used for small points. The reconstructed total lengths decrease relatively gradually from large to medium-sized (average 60 mm, 32%) and from medium-sized to small points (average just under 40 mm, 31%). This offers no evidence of repairs to the medium-sized and small points.

6. SIDE CONTOURS OF THE POINTS AND THEIR TYPOMETRICS

Horusitzky (2004) and I. Turk (2005) used the side contour to distinguish between flat and spindle-shaped points from P. z. (*Fig. 3.1*). Doyon (2017, Annexe 2), who gave precedence to geometric morphometry and volumetry over typology, performed a complex statistical analysis to examine a sample of 52 massive-based points from P. z. and 88 massive-based points from La Ferrassie, determining an independent morphotype (M04) and a variable group composed of six morphotypes (M01, M02, M03, M05, M07 and TDB). Doyon's morphotypes are derived from two basic types, i.e. massive- and split-based points. At P. z., his M04 morphotype includes a single flat example (No. 56), M01 includes twelve points (11 flat, 1 spindle-shaped), M02 twenty-four points (13 flat, 10 spindle-shaped, 1 undeterminable), M03 one point (spindle-shaped), M05 eight points (4 flat, 3 spindle-shaped, 1 undeterminable), M07 four points (1 flat, 1 spindle-shaped) and TDB two points (flat). In contrast, S. and M. Brodar believed that the points from P. z. were of a single type with variants (Brodar, Brodar 1983; M. Brodar 1985a; 1985b; 2009).

Point typology with typometrics primarily makes sense when viewed together with their function. As a hunting weapon prone to damage during use, the point had to be securely hafted,

6.1.



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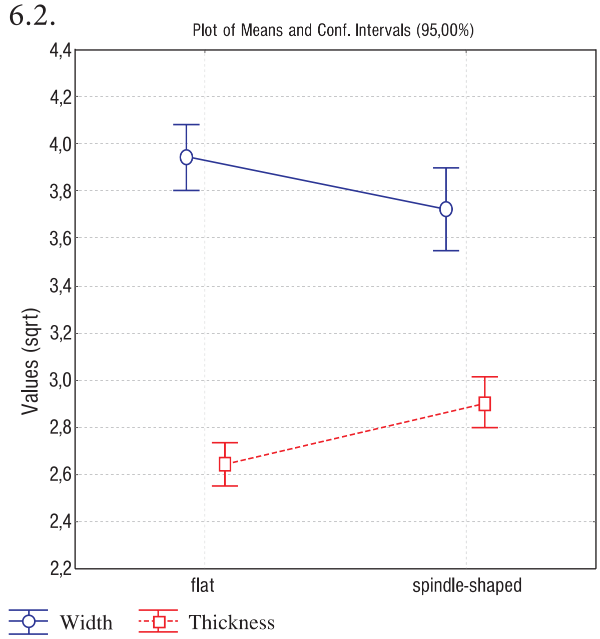


Fig. 6.1: Result of the analysis of variance (One-way ANOVA, p = 0.04 for reconstructed and 0.98 for preserved length) pertaining to the length of the flat and spindle-shaped points from P. z. (total n = 104; partial n = 65 – flat, 39 – spindle-shaped).
Sl. 6.1: Rezultat analize variance (One-way ANOVA, p = 0,04 za rekonstruirane mere in 0,98 za ohranjeno dolžino) dolžinskih mer ploščatih in vretenastih konic iz P. z. (skupni n = 104; delni n = 65 – ploščate, 39 – vretenaste).

Fig. 6.2: Result of the analysis of variance (One-way ANOVA, p = 0.05 for width and < 0.001 for thickness) pertaining to the width and thickness of the flat and spindle-shaped points from P. z. (total n = 104; partial n = 65 – flat, 39 – spindle-shaped).
Sl. 6.2: Rezultat analize variance (One-way ANOVA, p = 0,05 za širino in < 0,001 za debelino) širine in debeline ploščatih in vretenastih konic iz P. z. (skupni n = 104; delni n = 65 – ploščate, 39 – vretenaste).

durable, efficient and repairable. The points that have all these properties in the P. z. sample are the spindle-shaped points with an elongated medial part (Turk 2002). They represent a specific point type with the potential of evolving into a durable (ideal?) rod-like point of a round cross section.[10] In evolutionary terms, flat points are earlier and also represent a specific point type with its own development, though not towards the presumably ideal point.

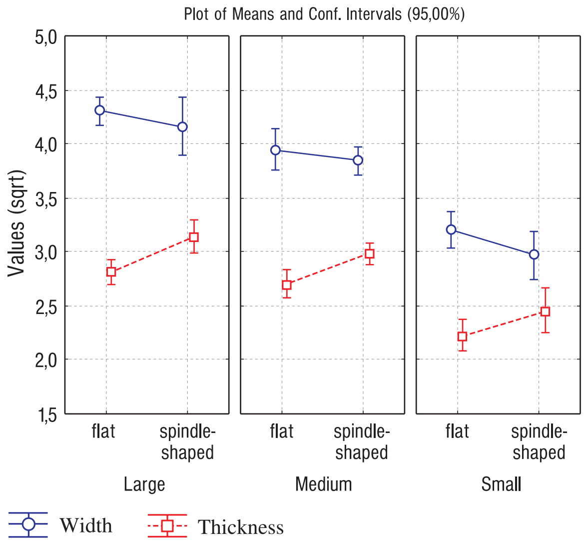
Flat points are made of relatively thin bone cortex and are of an even thickness except at the terminal of the base and in the apex. They are widest at the shaft-point junction. In shape and contour, they are similar to lanceheads with blunt edges.

Spindle-shaped points are made of relatively thick bone cortex, which is thickest in the medial part – again presumably at the shaft-point junction – and artificially thinned at both ends. The side contour resembles that of a spindle, hence the name. On average, they are shorter, narrower and thicker than flat points (*Fig. 4.1*). The metric differences are statistically significant (p = 0.04; 0.05 and < 0.001). There is no significant difference in the preserved length, even though we would expect it given the different shape and hence strength of the points.

Flat points have all reconstructed lengths significantly greater than spindle-shaped points, while the preserved length is the same for both (*Fig. 6.1*). They are also more variable in all the lengths, in width and thickness. Spindle-shaped points are (non)significantly narrower (p = 0.05) and significantly thicker than flat ones (p < 0.05) (*Fig. 6.2*); they are on average 2 mm narrower and just under 2 mm thicker. This is corroborated by the KW-test of the median for width (p = 0.04) and thickness (p < 0.001). The difference in width

[10] Several such points are known from the Aurignacian layers of the cave of Hohle Fels in the Swabian Jura (Wolf et al. 2016, Fig. 6.5).

6.3.



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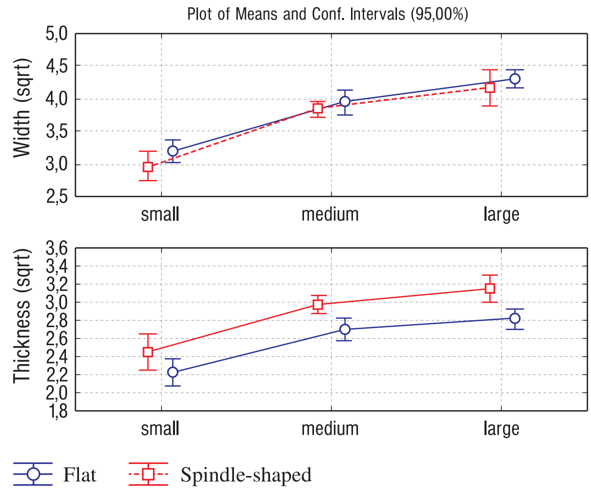

Fig. 6.3: Result of the analysis of variance (One-way ANOVA, $p < 0.001$ for width and thickness) pertaining to the width and thickness of the flat and spindle-shaped points from P. z. according to size classes (total n = 102; partial n = 30 – large flat, 10 – large spindle-shaped, 17 – medium-sized flat, 20 – medium-sized spindle-shaped, 16 – small flat, 9 – small spindle-shaped).
Sl. 6.3: Rezultat analize variance (One-way ANOVA, $p < 0,001$ za širino in debelino) širine in debeline ploščatih in vretenastih konic iz P. z. glede na velikost (skupni n = 102; delni n = 30 – velike ploščate, 10 – velike vretenaste, 17 – srednje ploščate, 20 – srednje vretenaste, 16 – majhne ploščate, 9 – majhne vretenaste).

Fig. 6.4: Result of the analysis of variance (One-way ANOVA, $p < 0.001$ for width and thickness) pertaining to the width and thickness of the flat and spindle-shaped points from P. z. according to size classes shown in graphically different manner to *Fig. 6.3* (total n = 102; partial n = 30 – large flat, 10 – large spindle-shaped, 17 – medium-sized flat, 20 – medium-sized spindle-shaped, 16 – small flat, 9 – small spindle-shaped).
Sl. 6.4: Slikovno drugačen prikaz rezultata analize variance (One-way ANOVA, $p < 0,001$ za širino in debelino) širine in debeline ploščatih in vretenastih konic iz P. z. glede na velikost, kot je prikazan v *sl. 6.3* (skupni n = 102; delni n = 30 – velike ploščate, 10 – velike vretenaste, 17 – srednje ploščate, 20 – srednje vretenaste, 16 – majhne ploščate, 9 – majhne vretenaste).

and thickness between flat and spindle-shaped points is highly significant ($p < 0.001$) for all size classes (*Fig. 6.3*). The difference between width and thickness is slightest (average 3 mm) in small spindle-shaped points. In small flat points, this difference is just over 3 mm. We see these significant properties of the spindle-shaped points as technological advancement. Narrower points have a greater penetrative capacity and thickening increases their strength to the power of two while hardly decreasing the ability of penetration. Thickness is limited with the thickness of the compact bone, which measures a maximum of 13 mm in the cave bear long bones, while the width is limited with the penetrating capacity and the width of the blank. Strength and penetration are balanced best in small spindle-shaped points that may have been used as arrowheads.

We verified the hypothesis of large point repair on medium-sized and large points, assuming that the populations of two size classes are interconnected and that the usual distal fragments (such as Nos. 8, 47, 53, 66, 95, 106, 136) of large flat points could be reshaped into medium-sized points. This reshaping would decrease the width of a point, while the thickness would remain unchanged. The same would occur when repairing medium-sized flat points with substantial apical damage (Nos. 12, 29, 32, 44, 90, 121, 122) and also when repairing some fragments of flat and spindle-shaped points (Nos. 9, 63, 103).

The highest number of durable spindle-shaped points can be found in the medium-size class, where they are double in number (20 specimens) compared with the large points (10 specimens). Quite the opposite is true of the flat medium-sized (17 specimens) and large points (30 specimens).

The numerical difference in size classes between the two types is statistically highly significant (χ^2 test: $p = 0.009$). No such statistically significant difference is observable between medium-sized and small points (χ^2 test: $p = 0.16$). This would suggest that, because of the shape of their side contours, spindle-shaped points were less prone to fracture at the shaft-point junction than flat ones. They were easier to repair if only sustaining insignificant damage to the distal part. This may have occurred several times in the span of their use. Frequent repairs would then have led to the prevailing use of spindle-shaped points in the medium-size class. Damaged medium-sized spindle-shaped points were repaired less frequently than large ones. They may even have been damaged less frequently.

The ANOVA result shows that width and thickness do not increase evenly with the size of the point (*Fig. 6.4*). Their increase from medium-sized to large points is much smaller that the increase from small to medium-sized points. This indicates that the medium-sized and large points are closer in both measures than small and medium-sized points, which could be explained with repairs mainly done on large points.

Small points are a class unto itself, both in size and the significant difference between flat and spindle-shaped points in terms of their width and thickness (*Fig. 6.4*). Because their repair does not seem reasonable and was presumably not done, they retained the original properties unlike the medium-sized points that may in part be the result of repairs to large points.

If point size depended solely on the random size of the bone blanks or fragments and there were no selection, we would have a sample with a full range of sizes (*Fig. 5.1*). It is, however, unlikely that people unselectively manufactured and used points. If the size of the points also depended on frequent repairs done outside the site, the point sample of this variability could only have accumulated at the site over a longer period or as a consequence of frequent visits in a short period.

7. LOCATION OF POINTS AND AREAS OF THE CAVE

The points were recovered from two separate areas of the cave, at the front and at the back. Because of the size of the cave and the relief of its ground, these two areas had different light and microclimatic conditions, consequentially also different sedimentation conditions. This brought about differences in the use of space (Brodar, Brodar 1983, 124, 127, 130), sedimentary environment and taphonomy (Verpoorte 2012), all of which resulted in differences between the points from the two areas.

There are significant differences between the number of small, medium-sized and large points at the entrance and at the back of the cave (χ^2 test: $p < 0.001$) (*Fig. 7.1*). The back area yielded all size classes in roughly equal numbers, while the entrance area revealed most large points and progressively less smaller ones.

The number of flat and spindle-shaped points of all three size classes at the entrance and at the back (*Tab. 1*) show a statistically significant difference only for small points (χ^2 test: $p = 0.04$). This difference could not have occurred selectively during excavations, because all small points save two or three were found at the back of the cave.

The presence of small points at the back cannot be related to hunting activities; they must have

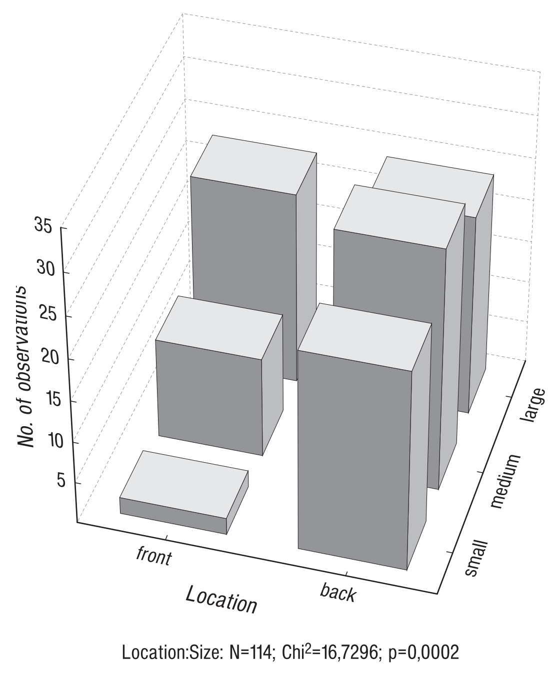

Fig. 7.1: Individual size classes of the points from P. z. according to cave areas (total n = 114; partial n = 29 – large back, 23 – large front, 29 – medium-sized back, 12 – medium-sized front, 24 – small back, 2 – small front).
Sl. 7.1: Zastopanost treh velikosti konic iz P. z. pri vhodu in v ozadju jame (skupni n = 114; delni n = 29 – velike, zadaj, 23 – velike, spredaj, 29 – srednje velike, zadaj, 12 – srednje velike, spredaj, 24 – majhne, zadaj, 2 – majhne, spredaj).

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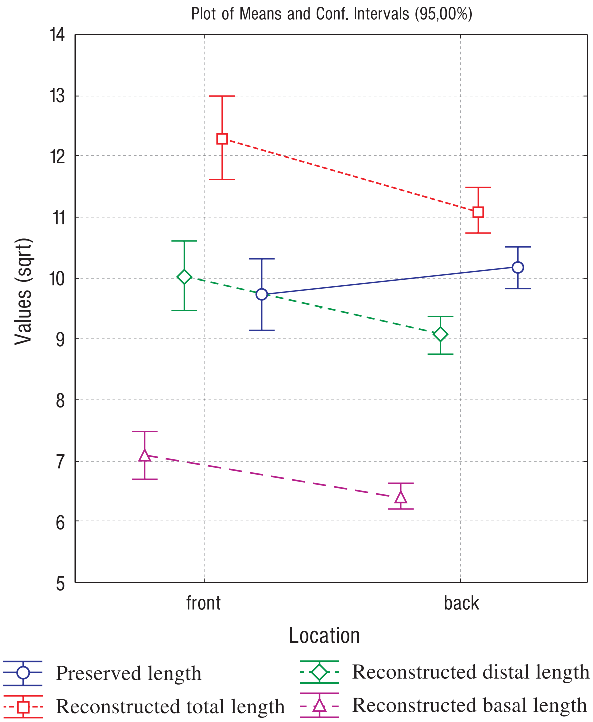

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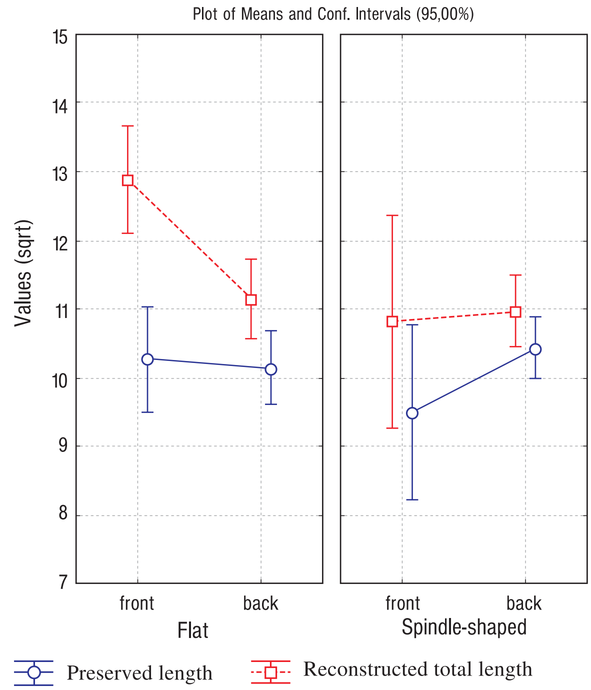


Fig. 7.2: Result of the analysis of variance (One-way ANOVA, p = 0.00 for all reconstructed measures and 0.16 for preserved length) pertaining to the length of the points from P. z. according to cave areas (total n = 117; partial n = 39 – front, 78 – back).
Sl. 7.2: Rezultat analize variance (One-way ANOVA, p = 0,00 za vse rekonstruirane mere in 0,16 za ohranjeno dolžino) dolžinskih mer konic glede na lokacijo (skupni n = 117; delni n = 39 – spredaj, 78 – zadaj).

Fig. 7.3: Result of the analysis of variance (One-way ANOVA, p = 0.000 for reconstructed length and 0.44 for preserved length) pertaining to the length of the points from P. z. according to cave areas and side contours (total n = 104; partial n = 22 – flat front, 10 – spindle-shaped front, 43 – flat back, 29 – spindle-shaped back).
Sl. 7.3: Rezultat analize variance (One-way ANOVA, p = 0,000 za rekonstruirano dolžino in 0,44 za ohranjeno dolžino) dolžinskih mer konic iz P. z. glede na lokacijo in profil (skupni n = 104; delni n = 22 – spredaj, ploščate, 10 – spredaj, vretenaste, 43 – zadaj, ploščate, 29 – zadaj, vretenaste).

Size	Side contour/Type	Location	N
large	flat	back	15
large	flat	front	15
large	spindle-shaped	back	6
large	spindle-shaped	front	4
medium	flat	back	12
medium	flat	front	5
medium	spindle-shaped	back	16
medium	spindle-shaped	front	4
small	flat	back	16
small	flat	front	0
small	spindle-shaped	back	7
small	spindle-shaped	front	2
Sum			**102**

Tab. 1: Number of points from P. z. according to size classes, side contour and cave areas.
Tab. 1: Zastopanost konic iz P. z. glede na velikost, profil in lokacijo.

arrived there for another reason, possibly as awls as suggested by a needle also found at the back of the cave (Brodar, Brodar 1983, Pl. 11: 27), they may have been stored there (Verpoorte 2012) or lost together with other points (Brodar, Brodar 1983). In the last two interpretations, primarily the spindle-shaped points may have served as arrowheads as they were more readily hafted onto an elder foreshaft in comparison with the flat points (Odar 2008).

The ANOVA shows the reconstructed total lengths of points and their parts to be significantly

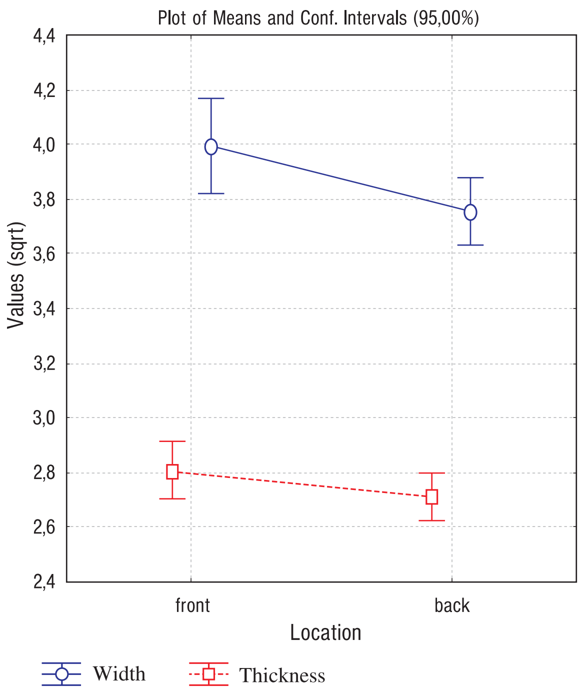


Fig. 7.4: Result of the analysis of variance (One-way ANOVA, p = 0.02 for width and 0.18 for thickness) pertaining to the width and thickness of the points from P. z. according to cave areas (total n = 117; partial n = 39 – front, 78 – back).
Sl. 7.4: Rezultat analize variance (One-way ANOVA, p = 0,02 za širino in 0,18 za debelino) širine in debeline konic iz P. z. glede na lokacijo (skupni n = 117; delni n = 39 – spredaj, 78 – zadaj).

smaller at the back than at the entrance; this is not the case for the preserved length, which shows no statistically significant differences between the two areas (*Fig. 7.2*). The variability of all lengths is greater in the points from the entrance area in spite of lower numbers, which may primarily be seen as the consequence of greater fragmentation of the points from the entrance. This may have any number of causes, from post-sedimentary fragmentation to the manipulation on the part of the Palaeolithic hunters. Post-sedimentary damage or breakage can mainly affect apexes of the points lying in the coarse-grained gravel sediments at the entrance, less of those in the loamy and fine-grained sandy layers at the back. It should be noted that Brodar's back dirt from the back of the cave did yield very small apical fragments (Odar 2014) that may have broken off in a post-sedimentary process or during the use of points such as spring hunting for cave bears in their den. The latter possibility is corroborated by indirect material evidence, i.e. a scapula with presumed lance damage (Withalm 2004).

It is difficult to only use post-sedimentary fragmentation to explain the difference in the reconstructed total length of flat and spindle-shaped points between both areas as established in the analysis of variance (*Fig. 7.3*). The flat points from the entrance area show a significantly greater reconstructed total length than those from the back. This means that such points from the entrance area survive in a poorer condition even though their reconstructed total length varies less in comparison with the points from the back. The reconstructed total lengths of the spindle-shaped points show no significant differences between the two areas. The condition of these points is the same between the two areas. The preserved lengths show no significant differences between the two areas, for either flat or spindle-shaped points. The latter show more variability in reconstructed and preserved measures for the points from the back, presumably on account of their greater numbers.

The points from the entrance area are significantly wider in comparison with those from the back, while thickness values show no significant differences (*Fig. 7.4*). The variability of width and thickness is greater for the points from the back, which is the exact opposite of the reconstructed lengths.

Because of the inhomogeneous variance for width ($p > 0.05$), we used the KW-test of the median for further distinction between flat and spindle-shaped points from the two areas of the cave. It shows the spindle-shaped points (n = 29) to be significantly thicker than flat ones (n = 43) only at the back of the cave, while the flat points (n = 22) are significantly wider than the spindle-shaped (n = 10) only at the entrance. The differences may be either chronological, accidental or have some other cause. If the points stored at the back included repaired points, then all the points from this area could have been narrower and thicker than the points at the entrance, as the users would have preferred to repair durable and more penetrable points.

8. STRATIGRAPHY OF POINTS

The horizontal distribution of the points with regards to the areas of the cave, but also their vertical distribution with regards to the stratigraphy offer important information in establishing

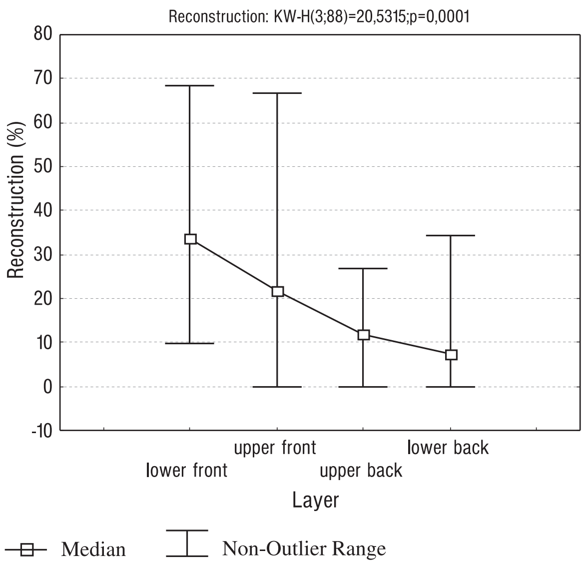


Fig. 8.1: Result of the analysis of the median pertaining to the shares of the absolute difference between the preserved length of the points from P. z. and their reconstructed total length according to layers and cave areas (total n = 88; partial n = 32 – lower layer back, 22 – upper layer back, 12 – upper layer front, 22 – lower layer front).
Sl. 8.1: Rezultat analize mediane deležev absolutne razlike med ohranjeno dolžino konic iz P. z. in rekonstruirano celotno dolžino po plasteh in lokaciji (skupni n = 88; delni n = 32 – spodaj, zadaj, 22 – zgoraj, zadaj, 12 – zgoraj, spredaj, 22 – spodaj, spredaj).

the changes that took place in time and space. The changes in time are presumed to indicate evolutionary trends, while the spatial differences may suggest differences in the use of the areas of the cave and different activities (Brodar, Brodar 1983; Verpoorte 2012). Different activities can only reliably be established when dealing with contemporary finds from both areas.

In contrast, establishing evolutionary trends, which S. and M. Brodar (1983, 109) refuted, requires the points to be chronologically clearly separate. This separation is not questionable for the points from the entrance area, found in Layers 5 and 7 clearly separated by the relatively thick and sterile Layer 6. The separation is not clear for the back of the cave, where points were unearthed across the whole thickness of Layers 5 and 4, i.e. in lower, middle and upper parts of each layer (*App. 2,* Column 13).

This begs the question of the chronological relationships between layers in both areas (ib.). The recent direct AMS ^{14}C dates of the points from different layers in the two cave areas have not helped in solving this issue (Moreau et al. 2015, Tab. 4; Rabeder, Pohar 2004, Tab. 1). The sample of dates is too small (N = 7) given its further stratification (n = 1, n = 2, n = 4) for the comparisons between individual layers to be reliable. The standard error ranges cover many generations of Palaeolithic hunters and gatherers, a period that allows for many changes, archaeologically and otherwise. Moreover, we cannot exclude the possibility that thousand or more year old bones were used in point manufacture. This makes the dates on their own an unreliable basis for drawing conclusions. However, they do suggest that the points from Layer 7 at the entrance and Layer 5 at the back may have been roughly contemporaneous (see Moreau et al. 2015, Tab. 4).[11]

In addition to the separate stratigraphy of both areas (Version 0), we also envisaged two versions (1 and 2) of the chronological relationships between the layers by area in the statistical analysis of the points. This increased the number of units per sample strata. In Version 1, we joined Layer 7 Front and Layer 5 Back, as well as Layer 5 Front and Layer 4 Back (*App. 2,* Column 15). In Version 2, we only joined Layer 5 Front and Layer 5 Back (*App. 2,* Column 16) (see Turk 2005).[12]

S. and M. Brodar (1983, 109) already discussed such synchronization of layers, but dismissed both of the above versions as unfounded and did not specifically address them.[13] In Version 1, they were disturbed by sterile Layer 6 at the entrance that separated Layers 7 and 5 with points, a situation that differed from the continuous distribution of points through Layers 5 and 4 at the back of the cave. In Version 2, they were disturbed by the clastic (*eboulis*) Layer 5 Front that was relatively thin in comparison with the relatively thick loamy Layer 5 Back. An additional problem was in the rich finds from Layer 7 Front not equalled at the

[11] The table erroneously states Layer 5 for the PZ-126 point instead of the correct Layer 7 (see Brodar, Brodar 1983, Pl. 7). Five of the seven dated points are flat. The fragmentary condition prevented two of the points to be identified; one may be spindle-shaped. A better thoughout selection of points for dating may have provided more useful results.

[12] The analysis in this article did not include points with atypical measures, as they would affect the ANOVA results with regards to the width of the points.

[13] As S. and M. Brodar (1983, 109) could not find a proper reason for correlating individual layers from both areas, they believed that the points from the two areas were roughly contemporaneous and did not differ in any way.

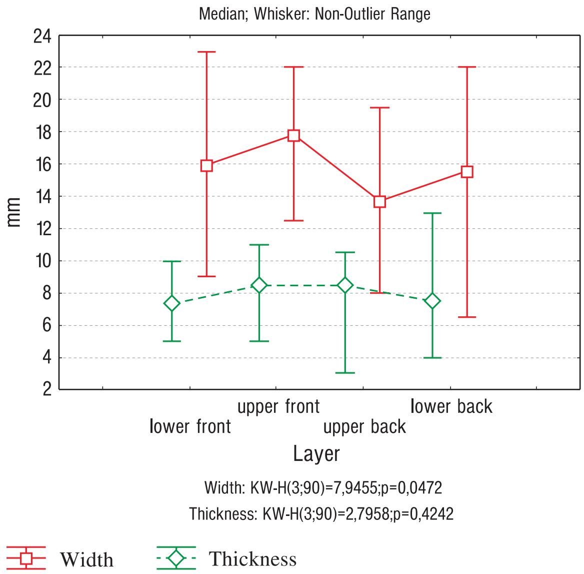


Fig. 8.2: Result of the analysis of the median pertaining to the width and thickness of the points from P. z. according to layers and cave areas (total n = 90; partial n = 33 – lower layer back, 22 – upper layer back, 13 – upper layer front, 22 – lower layer front).
Sl. 8.2: Rezultat analize mediane širine in debeline konic iz P. z. po plasteh in lokaciji (skupni n = 90; delni n = 33 – spodaj, zadaj, 22 – zgoraj, zadaj, 13 – zgoraj, spredaj, 22 – spodaj, spredaj).

back of the cave. They concluded that it cannot be explained by the effects of climate on sedimentation and human behavior.

Interpretation shifts in favour of Version 2 if we consider the possibility of a snow talus at the entrance and the associated protalus crioclastic sediments (J. Turk 2011). In such conditions, Layer 7 deposited in a relatively warm climate (ib.), when people did not need to seek shelter in the warmer cave interior unless staying there in early spring or late autumn. Layers 3–6 Front were deposited in a colder and more humid climate (ib.). A large snow talus at the entrance caused relatively thin layers of clasts (*eboulis*) to be deposited at the entrance, which grew thicker (protalus sediments) towards the interior, while percolating water from the melting snow washed increased quantities of loam to the back of the cave from the bare land above it. Layers 5 and 4 Back show slightly better conditions that allowed people to revisit P. z. after a long period of absence; the climate was still cold, though, and visitors mainly occupied the back of the cave. For Version 1 of joined layers from both parts of the cave, the following explanation for the use of the cave space is considered that takes into account the snow talus. In a relatively warm and humid climate (Layer 7 Front and Layer 5 Back), people used both areas, but for different purposes (see Brodar, Brodar 1983; Verpoorte 2012). In the subsequent, colder and moist period (Layer 5 Front and Layer 4 Back), they mainly used the back of the cave. This indicates that we should consider a long hiatus in sediment deposition between Layers 5 and 4 Back.

The suggestion that points were stored at the back, proposed on the basis of the differing condition of unstratified points from both areas (Verpoorte 2012), should be verified against the available stratigraphic samples from the two areas. This would allow us to get closer to the actual activities of the Palaeolithic hunters and gatherers at P. z. and avoid the effects of different archaeologically and geologically undetected (unconsidered) time spans.

The results of non-parametric analysis according to the original stratigraphic units (Version 0) separately for the two areas (*App. 2,* Column 14) only exceptionally support the premises on the evolutionary trends of points. For the most part, it merely indicates certain trends; we would require a larger sample for more reliable results.

The percentage shares of preserved lengths and reconstructed total lengths, as indicators of the state of fragmentation, show significant differences (p = 0.0001) per layer and cave area (*Fig. 8.1*). As already stated previously, the higher state of fragmentation of the points from the entrance area may be related to the different composition of sediments in both areas. This interpretation, however, is challenged by the statistically significant differences in fragmentation between the points from the upper and lower layer in each of the areas. We therefore believe that substantial damage occurred mainly during the use of points as hunting weapons (also see Chapter 11).

At the entrance, the points from the upper layer are wider and possibly thicker (?) than the points from the lower layer. At the rear of the cave, the points from the upper layer are narrower and possibly thicker (?) than the points from the lower layer (*Fig. 8.2*). Only the difference in width is significant (p = 0.04).

Flat points in both layers of the two areas are roughly twice as numerous (61–67%) as spindle-shaped ones. There is no evidence to suggest an increase in spindle-shaped points in the upper layers at either area.

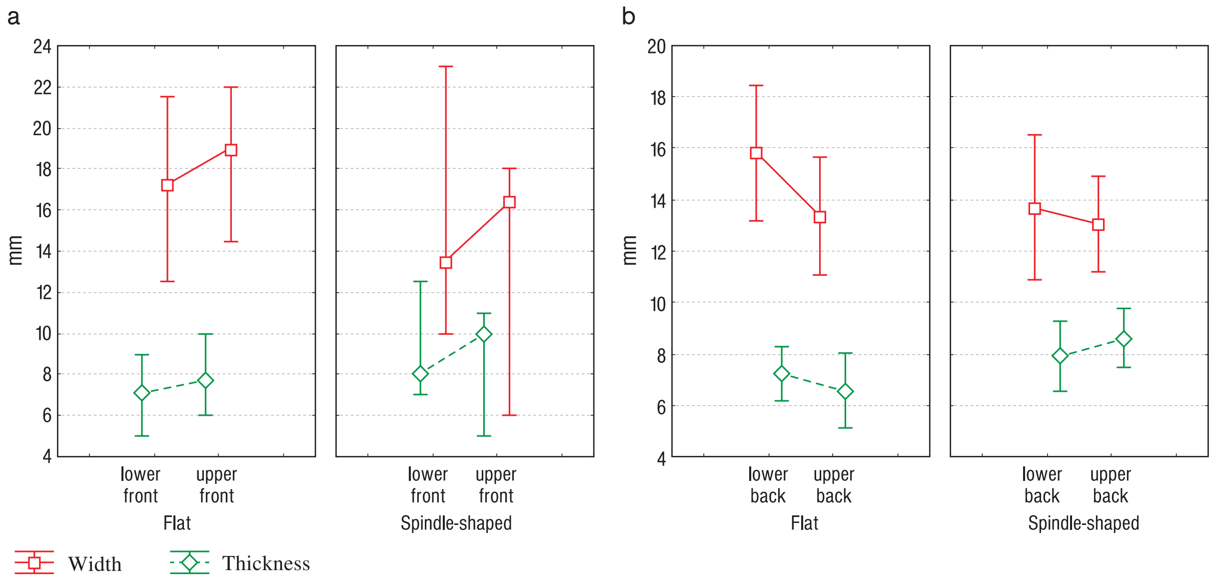


Fig. 8.3: Result of the analysis of the median pertaining to the width and thickness of the flat and spindle-shaped points from P. z. according to layers and cave areas. – (**a**) Total n = 29 – front; partial n = 12 – lower layer flat, 7 – upper layer flat, 6 – lower layer spindle-shaped, 4 – upper layer spindle-shaped. – (**b**) Total n = 53 – back; partial n = 19 – lower layer flat, 14 – upper layer flat, 12 – lower layer spindle-shaped, 8 – upper layer spindle-shaped).
Sl. 8.3: Rezultat analize mediane širine in debeline ploščatih in vretenastih konic po plasteh in lokaciji. – (**a**) Skupni n = 29 – spredaj; delni n = 12 – spodaj, ploščate, 7 – zgoraj, ploščate, 6 – spodaj, vretenaste, 4 – zgoraj, vretenaste. – (**b**) Skupni n = 53 – zadaj; delni n = 19 – spodaj, ploščate, 14 – zgoraj, ploščate, 12 – spodaj, vretenaste, 8 – zgoraj, vretenaste).

The multi-stratified sample of points separated by layer and area (*Figs. 8.3* and *8.4*) gave results on the limit of statistical significance ($p = 0.05$). Together with a low number of units in the sample strata, this should be taken in consideration when interpreting the results. Analysis shows that flat and spindle-shaped points from the entrance area tend to be wider and thicker in the upper layer, which may suggest technological improvement (*Fig. 8.3a*). The situation is quite different at the back: the flat points from upper layer tend to be narrower and thinner, whereas the spindle-shaped points from the same layer tend to be narrower and thicker (*Fig. 8.3b*); the latter may be seen as technological improvement, the former is a regression. Because the layers at the back are not clearly distinguishable in chronological terms, such an interpretation must be taken with all the more caution.

Spindle-shaped points may be narrower and thicker that the flat points particularly at the entrance, generally in both layers (*Fig. 8.4a*). At the back of the cave, the spindle-shaped points from upper layer are narrower than the flat ones, those from lower layer are thicker (*Fig. 8.4b*).

Version 1 of joined layers (*App. 2,* Column 15) provides results that partially correspond with the premises on the evolution of points. The spindle-shaped points from both layers are non-significantly narrower ($p = 0.17$) and significantly thicker ($p = 0.03$) than flat ones (*Fig. 8.5*). The flat points from the upper layer are non-significantly narrower and thinner, the spindle-shaped points non-significantly narrower and thicker. The former can be interpreted as regression in terms of strength, the latter as progress in terms of strength and penetrative capacity. These interpretations need to be taken with caution as not all the changes between layers are statistically significant.

Version 2 of joined layers (*App. 2,* Column 16) gave similar results. The zero values for some units of strata of Layer 7 led us to only analyse the points from both Layers 5 and from Layer 4. Each of the joined Layers 5 from both areas of the cave shares a higher degree of point fragmentation in comparison with the points from other layers (*Fig. 8.1*). The ANOVA results are isometric to those of Version 1 of joined layers shown in *Fig. 8.5*, but statistically non-significant ($p > 0.05$).

How is it possible to get isometric results for two so very different combinations of layers from the two areas? Only Layer 5 Front and Layer 5 Back are connected with the isometry of the ANOVA results. At the back of the cave, Layer 5 represents

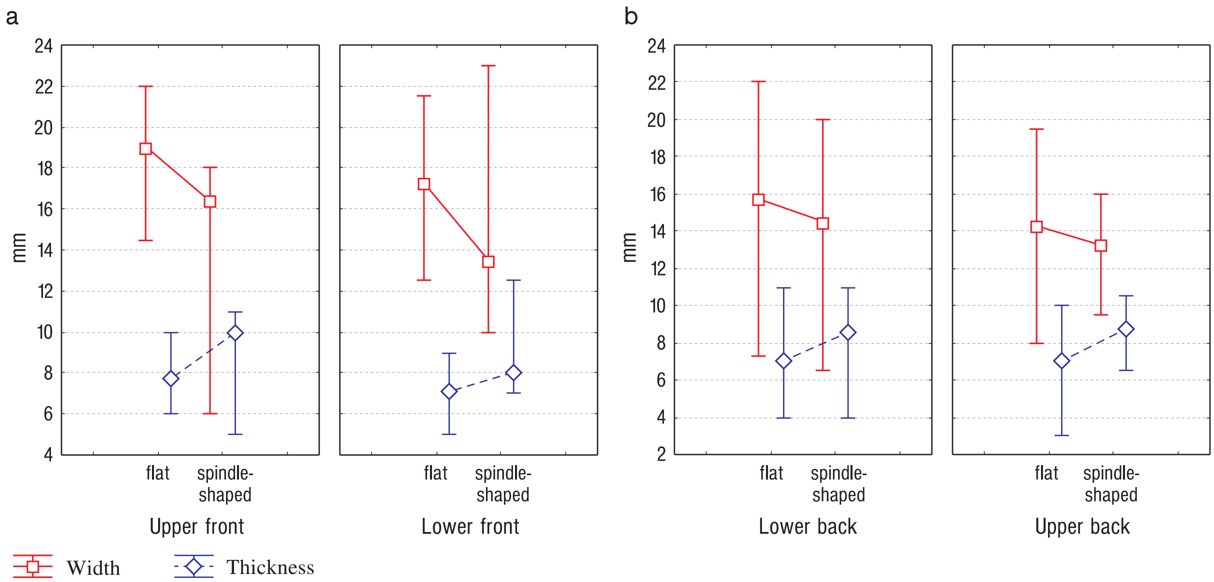


Fig. 8.4: Result of the analysis of the median pertaining to the width and thickness of the flat and spindle-shaped points from P. z. according to layers and cave areas. – (**a**) Total n = 29 – front, partial n = 12 – lower layer flat, 7 – upper layer flat, 6 – lower layer spindle-shaped, 4 – upper layer spindle-shaped. – (**b**) Total n = 53 – back, partial n = 19 – lower layer flat, 14 – upper layer flat, 12 – lower layer spindle-shaped, 8 – upper layer spindle-shaped).
Sl. 8.4: Rezultat analize mediane širine in debeline ploščatih in vretenastih konic iz P. z. po plasteh in lokaciji. – (**a**) Skupni n = 29 – spredaj, delni n = 12 – spodaj, ploščate, 7 – zgoraj, ploščate, 6 – spodaj, vretenaste, 4 – zgoraj, vretenaste. – (**b**) Skupni n = 53 – zadaj, delni n = 19 – spodaj, ploščate, 14 – zgoraj, ploščate, 12 – spodaj, vretenaste, 8 – zgoraj, vretenaste).

the lower layer in both versions. Not so with Layer 5 Front, which is the upper layer in Version 1 and the lower layer in Version 2. The stratigraphy at the entrance only changes for ten points (6 flat and 4 spindle-shaped), while the stratigraphy at the back remains the same for 62 points (39 flat and 23 spindle-shaped). This caused only minor changes of the ANOVA result in Version 2 of joined layers in comparison with Version 1.

In addition to the width and thickness of points, we also analysed their size in connection with side contour and stratigraphy according to Versions 1 and 2 of joined layers. Because of some zero values, this was not possible for the original stratigraphy. The more the sample is broken down, the greater the chances that the analyses of variance show certain previously unnoticed details and relationships.

The spindle-shaped points of all sizes in the upper layer are narrower than the flat points (*Fig. 8.6a,b*), but only the large ones are significantly narrower. The latter are also significantly narrower than those from the lower layer (*Fig. 8.6a*). In contrast, the medium-sized points from the upper layer are significantly wider than those from the lower layer (*Fig. 8.6a*); this may be interpreted as an evolutionary trend of increasing the strength of the medium-sized and increasing the penetrative capacity of the large spindle-shaped points.

In the analysis of variance for width, the detailed results only show a difference between Versions 1 and 2 of joined layers for the large spindle-shaped and medium-sized flat points. The greatest difference is in the latter (cf. Fig. *8.6a,b*). The detailed results of Version 2 of joined layers are not statistically significant.

The large and medium-sized spindle-shaped points from the lower layer are significantly thicker ($p < 0.05$) than the flat points of the same size; this is not the case for the small points (*Fig. 8.7a,b*). The large and small spindle-shaped points from the upper layer are significantly thicker ($p < 0.05$) than the flat points (*Fig. 8.7a,b*). Only the large and medium-sized flat points become significantly thicker in the upper layer (*Fig. 8.7a,b*). The spindle-shaped points of all size classes do not significantly differ in their thickness between lower and upper layers (*Fig. 8.7a,b*). The only evolutionary change occurred in the large and medium-sized flat points that increased in strength through the increased thickness. The greater thickness of medium-sized flat points in the upper layer corresponds with their greater width. However, the small number of units in

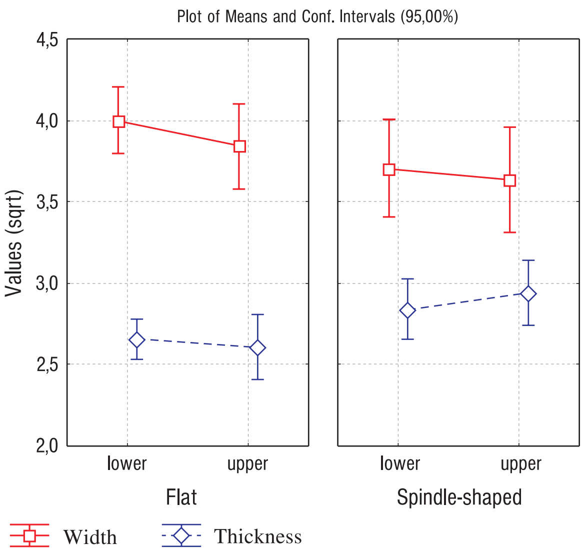
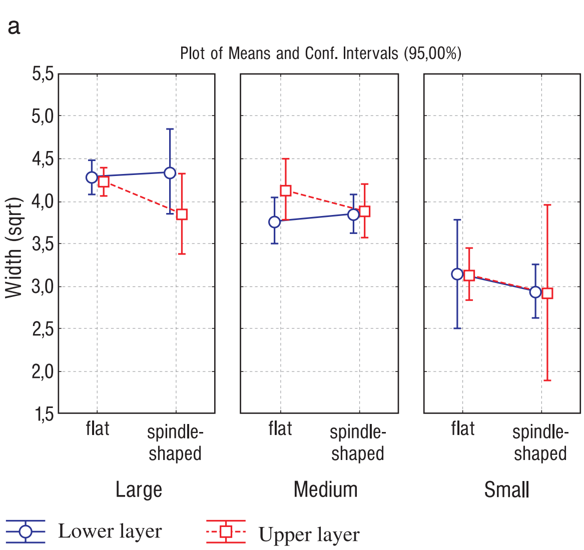


Fig. 8.5: Result of the analysis of variance (One-way ANOVA, p = 0.17 for width and 0.04 for thickness) pertaining to the width and thickness of the flat and spindle-shaped points from P. z. according to the joined layers of Version 1 (total n = 82; partial n = 31 – lower layer flat, 21 – upper layer flat, 18 – lower layer spindle-shaped, 12 – upper layer spindle-shaped).
Sl. 8.5: Rezultat analize variance (One-way ANOVA, p = 0,17 za širino in 0,04 za debelino) širine in debeline ploščatih in vretenastih konic iz P. z. po združenih plasteh prve različice (skupni n = 82; delni n = 31 – spodaj, ploščate, 21 – zgoraj, ploščate, 18 – spodaj, vretenaste, 12 – zgoraj, vretenaste).

individual sample strata calls for caution when drawing conclusions from these results.

In the analysis of variance for thickness, the detailed results only show a difference between Versions 1 and 2 of joined layers for the large flat points (cf. *Fig. 8.7a,b*).

The ANOVA result for individual layers of the two versions sheds light on questions pertaining to the manufacture, presumed use and repair of points. The large and medium-sized flat and spindle-shaped points from the upper layer do not differ in width and thickness, which indicates related populations (*Figs. 8.6a,b* and *8.7a,b*). The result for the width does not correspond with the presumed repairs of damaged points, at least not substantial repairs of damaged distal parts. In the lower layer, the same points only differ in width, in that the medium-sized points are narrower than the large ones, particularly the flat examples (*Fig. 8.6a*). The situation with unaltered thickness (*Fig. 8.7a,b*) corresponds with the presumed repairs. The small points, both flat and spindle-shaped in *Figs. 8.6* and *8.7* stand apart in their substantially smaller width and thickness compared with the medium-sized points. In both measures, they do not differ between layers and within them except for the upper layer where the spindle-shaped points are



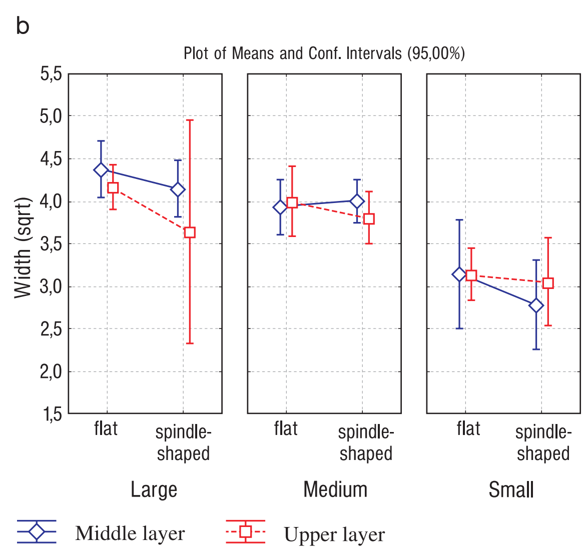


Fig. 8.6: Result of the analysis of variance (One-way ANOVA, p < 0.001 for both versions of joined layers) pertaining to the width of all three size classes of the flat and spindle-shaped points from P. z. given their origin in the lower (middle) or upper layer according to Versions 1 and 2 of joined layers. – (**a**) Version 1 (total n = 80, partial n = 3–17); – (**b**) Version 2 (total n = 62, partial n = 2–10).
Sl. 8.6: Rezultat analize variance (One-way ANOVA, p < 0,001 za obe različici združenih plasti) širine treh velikosti ploščatih in vretenastih konic iz P. z. glede na njihovo umestitev v spodnjo (middle) in zgornjo plast po prvi in drugi različici združenih plasti. – (**a**) Prva različica združenih plasti (skupni n = 80, delni n = 3–17); – (**b**) druga različica združenih plasti (skupni n = 62, delni n = 2–10).

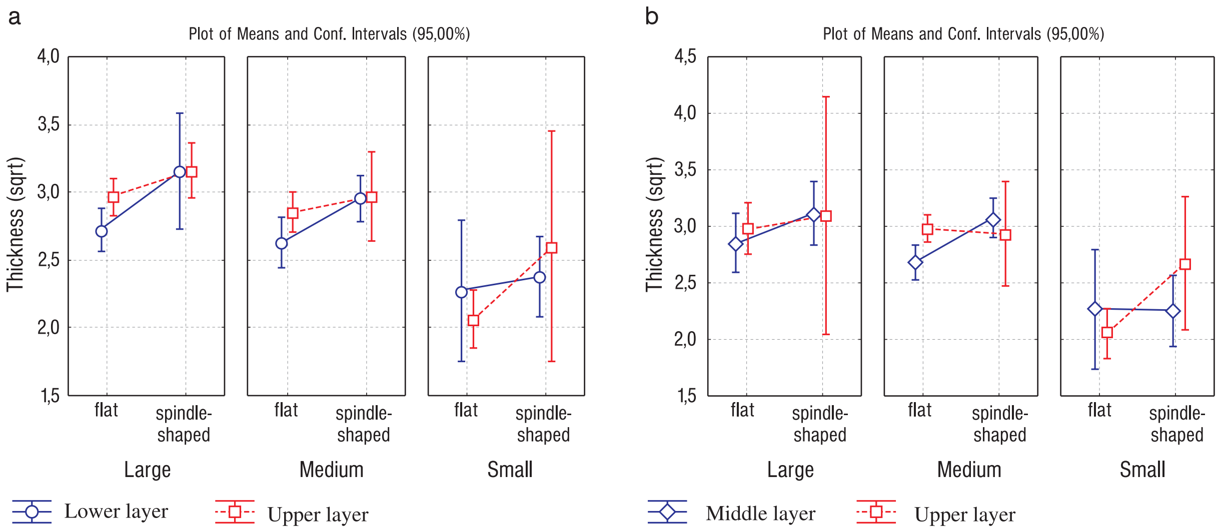


Fig. 8.7: Result of the analysis of variance (One-way ANOVA, $p < 0.001$ for both versions of joined layers) pertaining to the thickness of all three size classes of the flat and spindle-shaped points from P. z. given their origin in the lower (middle) or upper layer according to Versions 1 and 2 of joined layers. – (**a**) Version 1 (total n = 80; partial n = 3–17); – (**b**) Version 2 (total n = 62; partial n = 2–10).
Sl. 8.7: Rezultat analize variance (One-way ANOVA, $p < 0,001$ za obe različici združenih plasti) debeline treh velikosti ploščatih in vretenastih konic iz P. z. glede na njihovo umestitev v spodnjo (middle) in zgornjo plast po prvi in drugi različici združenih plasti. – (**a**) Prva različica združenih plasti (skupni n = 80; delni n = 3–17); – (**b**) druga različica združenih plasti (skupni n = 62; delni n = 2–10).

thicker than the flat ones (*Figs. 8.6a,b* and *8.7a,b*). As opposed to some of the large ones, the small points did not develop in correspondence with the presumed evolution. Within both layers, there are also great differences in the width and thickness of small and medium-sized points of both flat and spindle-shaped types, which indicates unrelated populations. These differences are substantially greater than the differences in width between large and medium-sized points in the lower layer. We infer from this that medium-sized points were not repaired as often as large ones.

9. CUTS AND INCISIONS ON THE POINTS

A puzzling feature of the points from P. z. is their cuts and incisions. Cuts occur on 30 points, incisions on 8 points. Cuts are short, transverse with regards to the longitudinal axis of the points and only occur on the edges (*Fig. 10.7:* 129). Incisions are long and occur on the front and back faces of the points, either in straight lines or in curves, either transversely or obliquely to the longitudinal axis (*Figs. 2.1:* 44,134; *2.3:* 74,113). Both were first noted by S. Brodar (1935; 1936–1937), who also provided a detailed description. Cuts and incisions are thoroughly discussed in the monograph on Potočka zijalka (Brodar, Brodar 1983).[14]

Cuts usually occur on the distal part, some also medially. The same is true of incisions, which have in rare cases also been documented on the base. The incisions on points Nos. 92 and 97 form a spiral, which is rare for points in general. Both cuts and incisions are barely visible with the naked eye. Parallels are rare and known on the points from French (Leroy-Prost 1979, 212, 245, 259) and other sites (Dobosi 2002, Fig. 7: 1).[15] As for the location of cuts, the claim that they can be found mainly on the proximal, medial-proximal and medial parts is incorrect (see Jéquier 2016). As stated above, cuts predominantly occur on the distal part.

S. and M. Brodar (1983) have observed cuts and incisions on roughly one third, i.e. 37 of the points from P. z. They noted each one, described their pattern in great detail (also see M. Brodar

[14] S. and M. Brodar used the term incisions for both.
[15] In the catalogue of points, the author does not state cuts for the Pb 50/91 point in Fig. 7:1 (also see Vértes 1955, Pl. XVI: 1). Neither does she mention incisions on the Pb 51/13 point, which we observed personally during our visit to the collection of points from Istállóskő. The Pb 50/91 point was on exhibition and not available for inspection.

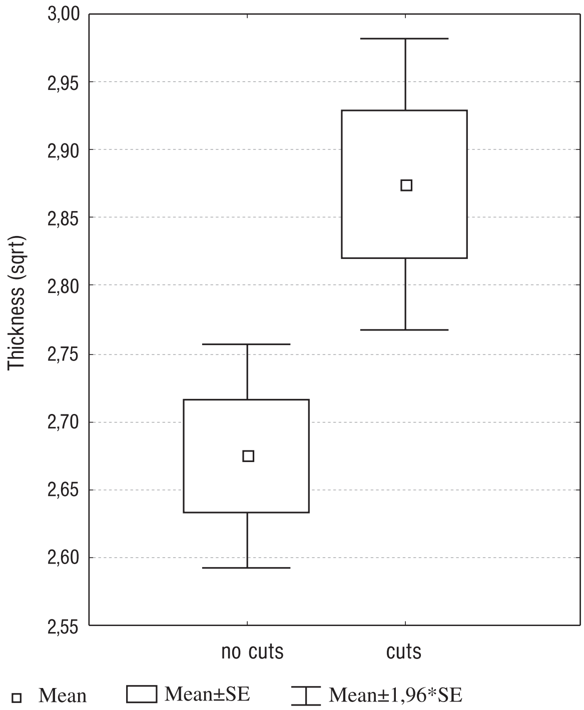


Fig. 9.1: Result of the t-test pertaining to the thickness of the points from P. z. with (n = 38) and without cuts and incisions (n = 78).
Sl. 9.1: Rezultat t-testa debeline konic iz P. z. z zarezami (n = 38) in brez njih (n = 78).

2009) and established that they were not dependent on the length of the points, that more points with medial cuts and incisions were found at the entrance (ib., 127) and that their pattern is the same in all areas of the cave and all layers. There are some points with cuts they missed (see Odar 2008). In *App. 2,* Column 17, we added six points to their list (Nos. 25, 29, 108, 132, 134 and 135) and omitted four (Nos. 1, 98, 110 and 131).

S. and M. Brodar did not analyse and interpret the role of the cuts and incisions in more detail, but did see the spirals on the points Nos. 44, 92 and 97 as decoration (Brodar, Brodar 1983, 132). In literature, several possible interpretations have been put forth:

– 1.) some incisions are decorative even though poorly visible;

– 2.) cuts were made so as to facilitate sharpening;

– 3.) cuts on middle-sized and even more so on small points were made so that the poison could better adhere to the point;

– 4.) cuts were symbolic in nature. The hunter made cuts to mark the point that performed particularly well during the hunt and remained only slightly damaged for a long time. If such a point then sustained substantial distal damage and was reworked into a middle-sized point, its cuts were transferred as well. Because of a personal relationship between the hunter and the weapon, cut visibility was of little consequence. In certain cases, longer and also curved lines served the same purpose (mostly our interpretation).

In order to verify these interpretations, we performed a statistical analysis only on the points with cuts and incisions visible with the naked eye; they are listed in *App. 2,* Column 17. If merely decorative, they would not mainly occur on the edges, as is the case, but also elsewhere. If cuts facilitated sharpening and their remains on numerous points were no longer visible (Odar 2008), how can we explain the preserved cuts? Further research should broaden the sample of points with cuts and divide them according to length, pattern and distribution on the different parts of the points (see M. Brodar 2009, 277). The distri-

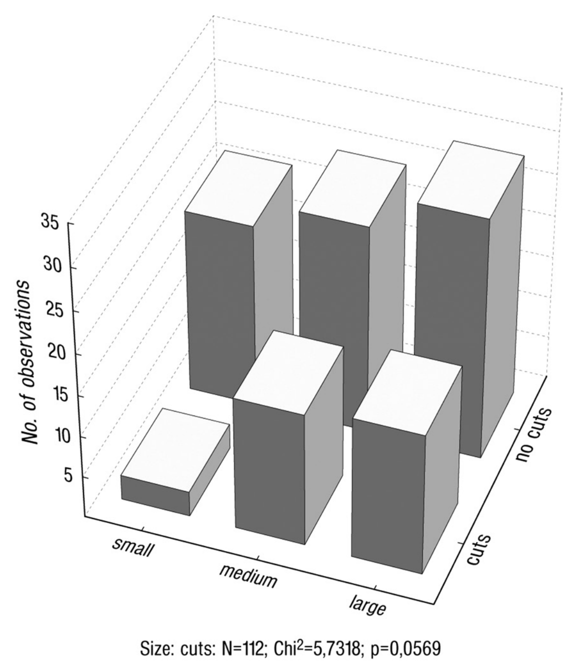


Fig. 9.2: Points from P. z. with cuts and incisions according to size classes (total n = 112; partial n = 29 – large without cuts and incisions, 17 – large with cuts and incisions, 25 – medium-sized without cuts and incisions, 16 – medium-sized with cuts and incisions, 22 – small without cuts and incisions, 3 – small with cuts and incisions.
Sl. 9.2: Zastopanost konic iz P. z. z zarezami po velikostnih razredih (skupni n = 112; delni n = 29 – velike brez zarez, 17 – velike z zarezami, 25 – srednje velike brez zarez, 16 – srednje velike z zarezami, 22 – majhne brez zarez, 3 – majhne z zarezami.

bution should also be viewed in connection with possible repairs, presumed remains of old medial cuts and presumed addition of new ones on the repaired, usually distal part (Nos. 51, 64, 65, 80).

The T-test (independent sample according to groups) of the basic measures (preserved length, reconstructed length, width, thickness) of the points with cuts and without them has shown those with cuts to be significantly thicker ($p = 0.005$) than the points without them (*Fig. 9.1*). Other measures show no significant differences, though the points with cuts do show a tendency towards greater length and width.

The number of points with cuts is almost equally high among large (17 : 29) and medium-sized (16 : 25), but substantially lower among the small points (3 : 22). The differences are statistically significant (*Fig. 9.2*) (χ^2 test: $p = 0.05$). The rare small points with cuts do not support the putative connection between cuts and the use of poisoned arrowheads. They do indicate a functional or symbolic difference between the cuts on the small points and those on all larger ones.

The ANOVA for the thickness of the points with and without cuts in relation to their size classes has shown the large points with cuts to be thicker (*Fig. 9.3*). Why? Considering the interpretation of cuts as technical help (Brodar, Brodar 1983; Odar 2008), it would be reasonable to make cuts mainly on the edges of the thickest and largest points where the greatest amount of material had to be removed by turning to obtain the desired shape. The presence of preserved cuts on the points of all sizes is not reasonable in this sense. If cuts were made in advance, just in case the point broke and needed repairing, the cuts on medium-sized and even more so the small points would be disturbing. The medium-sized points with and without cuts do not significantly differ from the large ones in thickness (*Fig. 5.3*). It was primarily the large points that were most worth repairing, less the medium-sized and least the small ones. Hence the interpretation of an exclusively technical role of cuts on all points does not seem plausible.

Useful in interpreting cuts is the ANOVA result for flat and spindle-shaped points with and without cuts, as well as for their measures. The spindle-shaped points with cuts do not significantly differ in preserved and reconstructed length, width and thickness from the spindle-shaped points without cuts. Not so for the flat points, where those with cuts have all the measures significantly greater

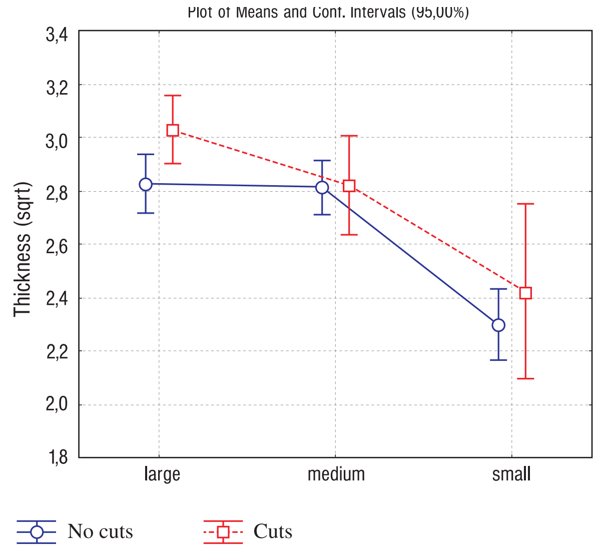


Fig. 9.3: Result of the analysis of variance (One-way ANOVA, $p < 0.001$) pertaining to the thickness of the points from P. z. with and without cuts and incisions according to size classes (total n = 113; partial n = 29 – large without cuts and incisions, 17 – large with cuts and incisions, 25 – medium-sized without cuts and incisions, 16 – medium-sized with cuts and incisions, 22 – small without cuts and incisions, 4 – small with cuts and incisions).

Sl. 9.3: Rezultat analize variance (One-way ANOVA, p < 0,001) debeline konic iz P. z. z zarezami in brez njih glede na velikost konic (skupni n = 113; delni n = 29 – velike brez zarez, 17 – velike z zarezami, 25 – srednje brez zarez, 16 – srednje z zarezami, 22 – majhne brez zarez, 4 – majhne z zarezami).

than those without (*Fig. 9.4a,b*). These are the most durable points, apart from the spindle-shaped ones, that are least prone to hunting damage. It is probably not a coincidence that spindle-shaped points include relatively more examples with cuts (14 : 25) than flat ones (18 : 45).

The measures of flat and spindle-shaped points with and without cuts were also analysed according to the areas of the cave they were found in. The ANOVA shows that the flat points with cuts from the back are significantly longer, wider and thicker that the flat points without cuts (*Fig. 9.5a–c*). For spindle-shaped points, there are no differences between the points with and without cuts with regards to the area of the cave. Also, there are no significant differences between the points with and without cuts found at the entrance. There appears to be a distinction between the flat points from the back in terms of strength: points with cuts (solid) and those without them (less solid); only 12 belong to the former and as many as 31 to the latter. The question is why the back of the cave

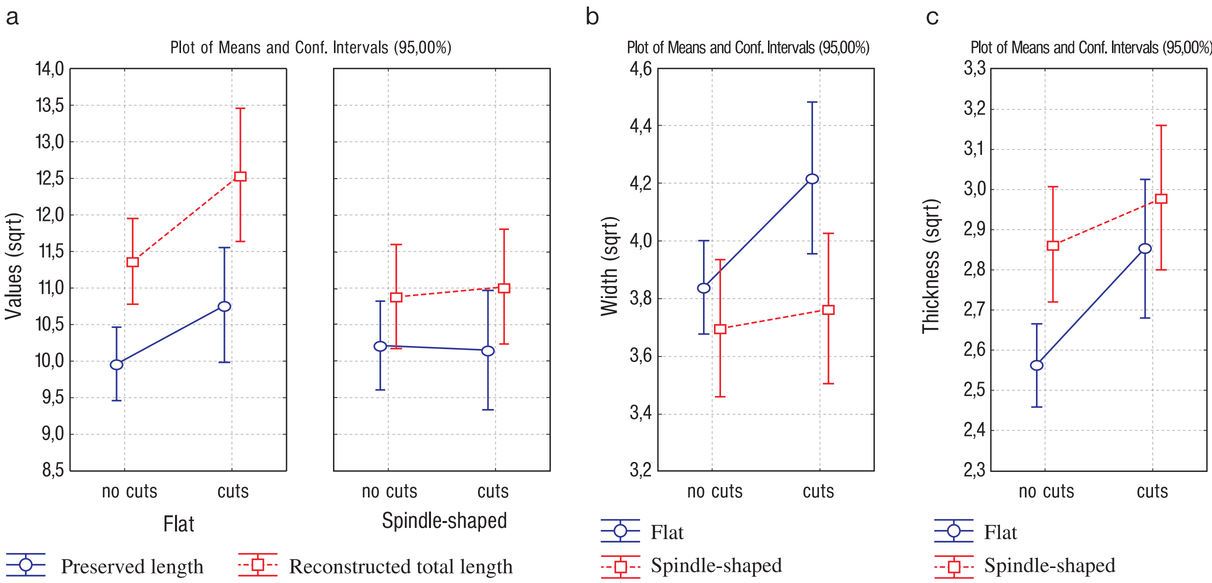


Fig. 9.4: Result of the analysis of variance (One-way ANOVA, p = 0.34 for preserved length, 0.02 for reconstructed length, 0.01 for width and 0.001 for thickness) pertaining to the preserved length, reconstructed total length (**a**), width (**b**) and thickness (**c**) of the flat and spindle-shaped points from P. z. with and without cuts and incisions (total n = 102; partial n = 45 – flat without cuts and incisions, 18 – flat with cuts and incisions, 25 – spindle-shaped without cuts and incisions, 14 – spindle-shaped with cuts and incisions).
Sl. 9.4: Rezultat analize variance (One-way ANOVA, p = 0,34 za ohranjeno dolžino; 0,02 za rekonstruirano dolžino; 0,01 za širino in 0,001 za debelino) ohranjene dolžine in rekonstruirane celotne dolžine (**a**), širine (**b**) ter debeline (**c**) ploščatih in vretenastih konic iz P. z. z zarezami in brez njih (skupni n = 102; delni n = 45 – ploščate brez zarez, 18 – ploščate z zarezami, 25 – vretenaste brez zarez, 14 – vretenaste z zarezami).

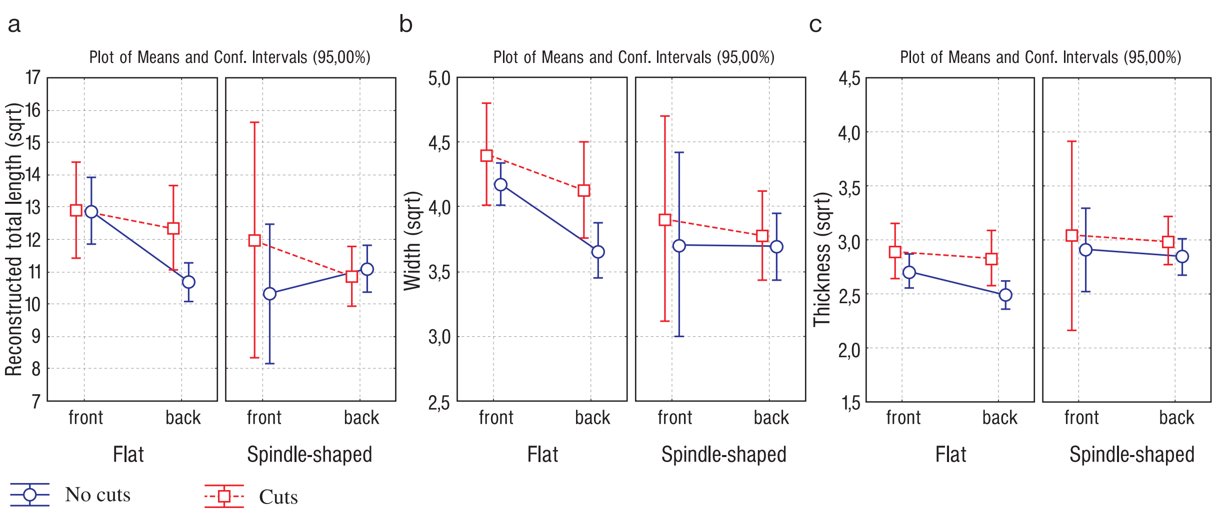


Fig. 9.5: Result of the analysis of variance (One-way ANOVA, p < 0.001 for reconstructed length, 0.004 for width and 0.001 for thickness) pertaining to the reconstructed total length (**a**), width (**b**) and thickness (**c**) of the flat and spindle-shaped points from P. z. with and without cuts and incisions according to cave areas (total n = 101–103; partial n = 31 – flat without cuts and incisions back, 12 – flat with cuts and incisions back, 14–16 – flat without cuts and incisions front, 6 – flat with cuts and incisions front, 18 – spindle-shaped without cuts and incisions back, 10 – spindle-shaped with cuts and incisions back, 7 – spindle-shaped without cuts and incisions front, 3 – spindle-shaped with cuts and incisions front).
Sl. 9.5: Rezultat analize variance (One-way ANOVA, p < 0,001 za rekonstruirano dolžino; 0,004 za širino in 0,001 za debelino) rekonstruirane celotne dolžine (**a**), širine (**b**) ter debeline (**c**) ploščatih in vretenastih konic iz P. z. z zarezami in brez njih na lokaciji spredaj in zadaj (skupni n = 101–103; delni n = 31 – ploščate, zadaj, brez zarez, 12 – ploščate, zadaj, z zarezami, 14–16 – ploščate, spredaj, brez zarez, 6 – ploščate, spredaj, z zarezami, 18 – vretenaste, zadaj, brez zarez, 10 – vretenaste, zadaj, z zarezami, 7 – vretenaste, spredaj, brez zarez, 3 – vretenaste, spredaj, z zarezami).

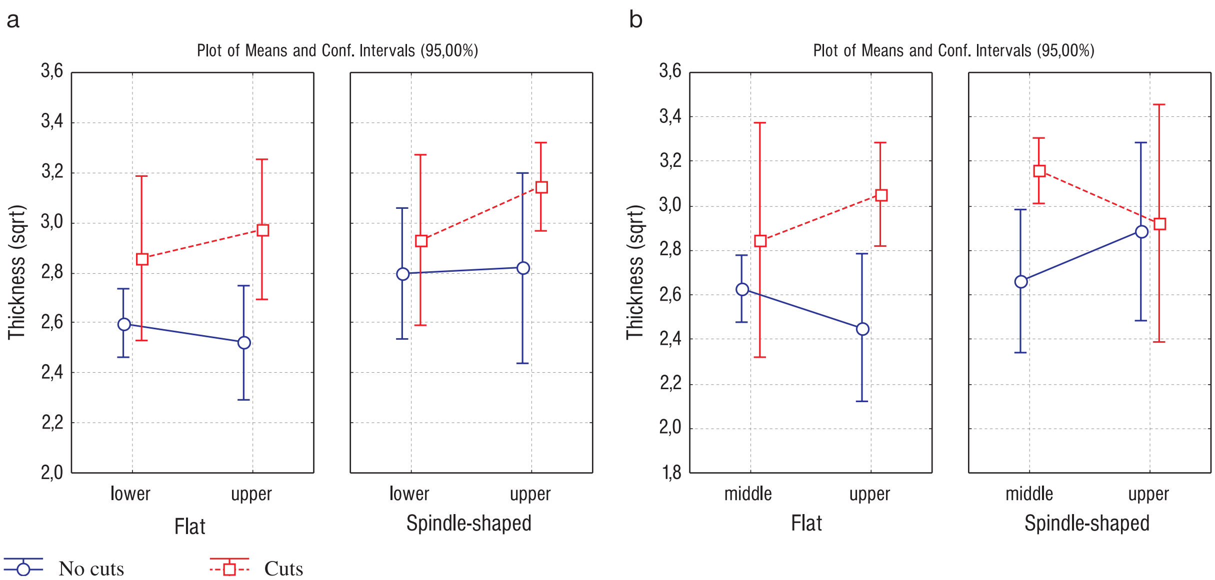


Fig. 9.6: Result of the analysis of variance (One-way ANOVA, p = 0.008 for Version 1 of joined layers and p = 0.01 for Version 2) pertaining to the thickness of the flat and spindle-shaped points from P. z. with and without cuts and incisions according to joined layers. – (**a**) Version 1 (total n = 81; partial n = 24 – flat without cuts and incisions lower layer, 7 – flat with cuts and incisions lower layer, 17 – flat without cuts and incisions upper layer, 4 – flat with cuts and incisions upper layer, 12 – spindle-shaped without cuts and incisions lower layer, 6 – spindle-shaped with cuts and incisions lower layer, 6 – spindle-shaped without cuts and incisions upper layer, 5 – spindle-shaped with cuts and incisions upper layer). – (**b**) Version 2 (total n = 63; partial n = 20 – flat without cuts and incisions middle, 5 – flat with cuts and incisions middle, 12 – flat without cuts and incisions upper layer, 3 – flat with cuts and incisions upper layer, 9 – spindle-shaped without cuts and incisions middle, 6 – spindle-shaped with cuts and incisions middle, 4 – spindle-shaped without cuts and incisions upper layer, 4 – spindle-shaped with cuts and incisions upper layer).
Sl. 9.6: Rezultat analize variance (One-way ANOVA, p = 0,008 za prvo različico združenih plasti in p = 0,01 za drugo) debeline ploščatih in vretenastih konic z zarezami in brez njih iz P. z. po združenih plasteh. – (**a**) Prva različica združenih plasti (skupni n = 81; delni n = 24 – ploščate, spodaj, brez zarez, 7 – ploščate, spodaj, z zarezami, 17 – ploščate, zgoraj, brez zarez, 4 – ploščate, zgoraj, z zarezami, 12 – vretenaste, spodaj, brez zarez, 6 – vretenaste, spodaj, z zarezami, 6 – vretenaste, zgoraj, brez zarez, 5 – vretenaste, zgoraj, z zarezami). – (**b**) Druga različica združenih plasti (skupni n = 63; delni n = 20 – ploščate, sredina, brez zarez, 5 – ploščate, sredina, z zarezami, 12 – ploščate, zgoraj, brez zarez, 3 – ploščate, zgoraj, z zarezami, 9 – vretenaste, sredina, brez zarez, 6 – vretenaste, sredina, z zarezami, 4 – vretenaste, zgoraj, brez zarez, 4 – vretenaste, zgoraj, z zarezami).

yielded spindle-shaped (10 with and 18 without cuts), but also flat points, both solid and less solid ones. Were they stored there for future use (Verpoorte 2012)? Were they lost (Brodar, Brodar 1983)? Were they offered (Odar 2015)? Are they the result of a combination of different habits and practices? Or are they there by coincidence? Given the available evidence, it is as yet not possible to offer a clear answer supported by arguments that would correspond with the results of the analysis of a stratified sample.

The points with and without cuts can be statistically analysed according to layers in connection with other variables only by joining layers from both areas of the cave after Versions 1 and 2 (*App. 2*, Columns 15 and 16). The analysis according to single layers (ib., Column 14) is not reasonable due to insufficient data for most sample strata.

The conditions for an ANOVA analysis are met for thickness and Version 1 of joined layers; for thickness and Version 2, the variance is inhomogeneous ($p < 0.05$).

For the upper layer in both versions of joined layers, flat points with cuts are significantly thicker that flat points without cuts (*Fig. 9.6a,b*). The same is true of the width and Version 1 of joined layers. In both versions, the analysis indicated a tendency of thickening flat points with cuts and thinning flat points without cuts between the upper and lower layer (*Fig. 9.6a,b*). All this suggests a connection between cuts and the strength of the points that may best be interpreted by symbolic markings of more durable points. There is also the possibility that, in the lower layer, spindle-shaped points with cuts were significantly thicker than those without cuts (*Fig. 9.6b*). In both layers, the points with cuts are much more common among the spindle-shaped than among the flat type (see numerical data in the caption to *Fig. 9.6*), which also suggests a connection between cuts and strength of the points.

10. MANUFACTURE, REPAIR AND USE OF POINTS

We believe that nearly all the points from P. z. are made of long bone cortex. Standing apart are Nos. 9 and 86+125, made of bovine (muskox?), ibex or wild sheep (mouflon) horn, and No. 133 that is made of deer antler, possibly also No. 28. Doyon (2017) states ten (19%) of the altogether 52 analysed points to be made of deer antler (Nos. 9, 28, 39, 48, 49, 55, 73, 81, 105, 117) and one of ivory (No. 134). Of the ten examples six are flat, three spindle-shaped and one undeterminable. Similarly, Pacher (2010) writes that up to 40% of all points may be made of antler and Nos. 92 and 134 of ivory. Slightly different information is given by Jéquier (2016), who refutes the use of ivory. As none of the points has been subjected to a microscopic tissue analysis, all information pertaining to the material must be taken with caution.

S. and M. Brodar (1983, 124), later also Hahn (1988, 12) posited that (some of) the points from P. z. were made of cave bear bones. This is highly likely because coarse trabecular tissue present on several points is characteristic of the long bones of some mammal species including cave bears, the remains of which represent over 99% of all fossil remains from the cave. The thickness of the points (average 7.7 mm) corresponds better with the thickness of the long bone cortex of cave bears and other large mammals than with the thickness of the red or reindeer antler compact tissue. The distribution of thickness is presumably bimodal with the first peak at 5–6 mm and the second at 8–9 mm (*Fig. 10.1*). In theory, antler points could belong to the first peak and bone points to the second. However, the bimodal distribution of thickness is probably linked to typology, i.e. either flat or spindle-shaped points (see *Fig. 12.5*), not to material. Only three points (Nos. 15, 77 and 78) are made of very thin bone cortex with a smooth surface of the medullary canal, which speaks against the bones of carnivores or large animals in general. The rather thick points Nos. 71 and 75 also have a smooth medullary canal, but the surface of the latter is probably artificially smoothed.

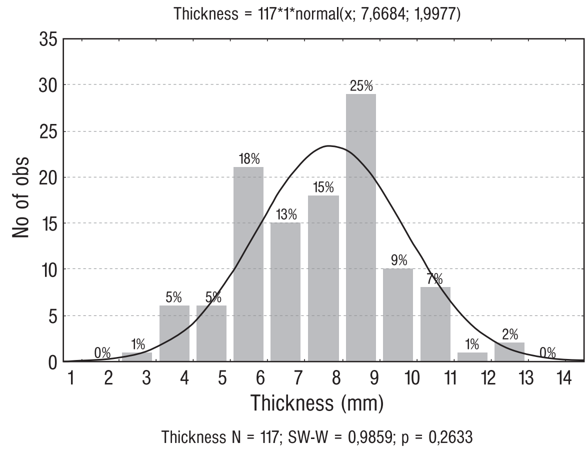


Fig. 10.1: Distribution of the points from P. z. (n = 117) according to thickness.
Sl. 10.1: Porazdelitev debelin vzorca konic P. z. (n = 117).

Points could be made from the evenly thick bone cortex of the central part of the femur or humerus diaphyses belonging to dead cave bears, as well as from the unevenly thick bone cortex of the metaphyses. On a femur, the most suitable part was the flat surface of the posterior side, on a humerus that on the medial side. These surfaces enabled the manufacture of points up to 23 cm long, on a femur possibly even a centimetre or so more. The points made from femora are identifiable in the presence of the *foramen nutritium* (Nos. 35, 94 and possibly 41), those from humeri in the torsion of the cortex (Nos. 19, 61, 79, 120, 130) and in the thinning of the cortex in the direction of the distal epiphysis (Nos. 2, 90, 120 and 124). The cross section of the compact bone with the remains of the medullary cavity and spongy tissue suggest that several points (Nos. 60, 80, 101, 109, 122, 136) may have been made from other cave bear long bones such as radius and ulna. Apart from these, the metapodials and femora of large ungulates may also have been used.

The main problem in the manufacture of large points was obtaining appropriate splinters, 15–20 cm or more long. We are of the opinion that there could not have been many, if any, suitable bone fragments at the site (*contra* Brodar, Brodar 1983). This opinion is based on the examination of roughly 900,000 bone fragments belonging to several thousand cave bear individuals from the 260 m^3 sediments excavated at the cave site of Divje babe I. The solution to the problem is in splitting diaphyses with the help of a pair of holes, made one below the other, and a pair of wedges with a blunt tip, one of which is driven into the upper hole while the other rests in the lower hole and transfers the force of the blows to the lower side as well. After removing the epiphyses, the diaphysis of a humerus or femur can be simply and quickly, with a little bit of practice also in a more or less controlled manner (depending on preparation such as the leading incision), split lengthwise and thus made into appropriately long splinters. Some of the numerous holes in the cave bear long bones recovered from the Aurignacian layers of P. z. and Mokriška jama (Brodar, Brodar 1983; M. Brodar 1985a; 1985b) may be connected with this technique of splinter manufacture. No such holes have been documented on the bones from the Mousterian layers of Divje babe I, neither has such a high number of holes been documented at Gravettian sites, from a time when the cave bear was not yet extinct. M. Brodar (2009, 329) already pointed out that holes on bones were a temporally limited phenomenon.

The rough shape of a point can be obtained from a bone splinter of a certain width by incising the contour of the point and breaking off the bone along the incision by striking it (see Turk et al. 2001, Fig. 25). Such a process is much easier that others suggested elsewhere, such as the double longitudinal grooving procedure (Leroy-Prost 1975, 76; Tartar, White 2013; Odar 2008; 2015), used in the Gravettian, or the simple longitudinal splitting of antlers from the top (i.e. cleavage) as suggested by Tejero, Christensen and Bodu (2012), and repeated by Doyon (2013, Fig. 2.4) for antler split-based points. The last suggestion is close to our own, but is more efficient for massive antlers than for tubular long bones. It lacks an essential part to be simpler and more effective: a hole or indentation made beforehand in the antler beam, into which a blunt indirect percussor is placed that split the beam lengthwise from the side rather than the top. The procedure can be repeated on each of the two halves of the antler beam to obtain narrow blanks, which the procedure as proposed by Tejero and colleagues does not foresee. The edges and faces can later be worked by grinding and planing (Brodar, Brodar 1983; Tartar, White 2013). Planing leaves behind facets; as numerous points from P. z. show facets, we suppose that they were often finished by planing. The process, however, required the point to be firmly secured into a vice, which was not a simple undertaking only using bare hands and simple tools.

Apart from the edges, the faces were also worked with the aim of thinning the cortical bone at the end of the basal and distal parts. The base was usually and logically worked less that the distal part. Less logical is the fact that the base was rounded or even pointed, given that the points were hafted.

Thinning the bone cortex on the basal and distal parts may also have been aimed at obtaining the most straight point contour from the flexed blank. This was done in a number of ways: only thinning the exterior side of the cortex (e.g. Nos. 3, 99), the exterior basal and interior distal sides (e.g. Nos. 11, 31, 42, 64, 82, 111), the exterior and interior sides of the distal part and only the exterior side of the basal part (e.g. Nos. 4, 10, 50, 65, 71, 75, 80, 101, 130) or both ends of the point on both sides that produced a completely or almost completely transformed cortex (e.g. Nos. 20, 22, 30, 38, 41, 44, 51, 55, 62, 97).

Some of the points with bilaterally thinned distal parts may have been re-sharpened (e.g. Nos. 65, 80) (*Figs. 10.6 and 12.3*). The location of maximum thickness and the substantial medial part would confirm such an observation; both are disproportionate to point size.

A specific manufacture technique has been noted for the presumably re-sharpened point No. 68. The exterior of its cortex is unworked; the point is only thinned at basal and distal ends on the interior side of the bone cortex so that it is thickest in the medial part where the original cortex thickness survives, while the base is polished smooth and has sharp edges.

The point exhibiting the highest degree of rework is No. 92 (S. and M. Brodar 1983, Pl. 10), which stands apart from others in all aspects. Its cross section is almost round, indicating that the natural form of the material (ivory?) is most extensively reshaped.

Primarily based on the size of the surface bearing the remains of trabecular tissue and the medullary cavity, we can distinguish between several arbitrary phases of bone cortex transformation.[16] This does not pertain to its edges, the working of which was inevitable in manufacture. The transformation of the cortex is linked to the amount of work that goes into the manufacture of a point, with the higher amount of work usually resulting in a higher quality of the finished product. For large points, intended for hunting dangerous animals,

[16] The preserved trabecular tissue on osseous points has already been studied by Hahn (1988, 12), who did not attempt to interpret the different degrees of cortex transformation in any way.

high-quality manufacture was important because a reliable, i.e. durable point meant reduced risk for the hunter. Cortex transformation may also have been influenced by repeated reworking caused by the damage sustained during hunting.

We informatively analysed the arbitrarily determined insignificant and substantial cortex transformation (*App.2,* Column 18). Most points with substantial cortex transformation are spindle-shaped (21 spindle-shaped, 13 flat), while most points with insignificant cortex transformation are flat (35 flat, 7 spindle-shaped). There is a statistically very significant difference in the numbers of transformed points (χ^2 test: $p < 0.001$). The ANOVA has shown a relation between the degree of bone cortex transformation and the shape/type of a point (flat, spindle-shaped); bone cortex transformation and point type are interdependent properties.

Flat points with substantial cortex transformation are significantly thicker than those with insignificant cortex transformation (*Fig. 10.2*). No such difference has been observed in spindle-shaped points. The latter with substantial bone cortex transformation are significantly thicker that the flat points with substantial cortex transformation. The manufacturers apparently invested more effort

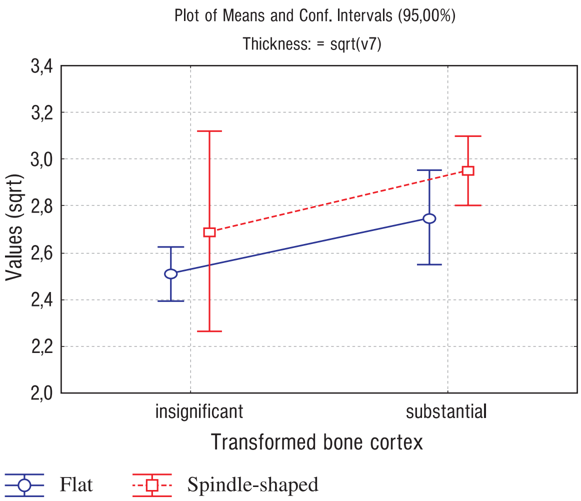


Fig. 10.2: Result of the analysis of variance (One-way ANOVA, p < 0.001) pertaining to the thickness of the flat and spindle-shaped points from P. z. according to the degree of bone cortex transformation (total n = 76; partial n = 35 – flat insignificant transformation, 13 – flat substantial transformation, 7 – spindle-shaped insignificant, 21 – spindle-shaped substantial transformation).
Sl.10.2: Rezultat analize variance (One-way ANOVA, p < 0,001) za debelino ploščatih in vretenastih konic iz P. z. v povezavi s preoblikovanjem kostne lupine (skupni n = 76; delni n = 35 – ploščate, neznatno, 13 – ploščate, znatno, 7 – vretenaste, neznatno, 21 – vretenaste, znatno).

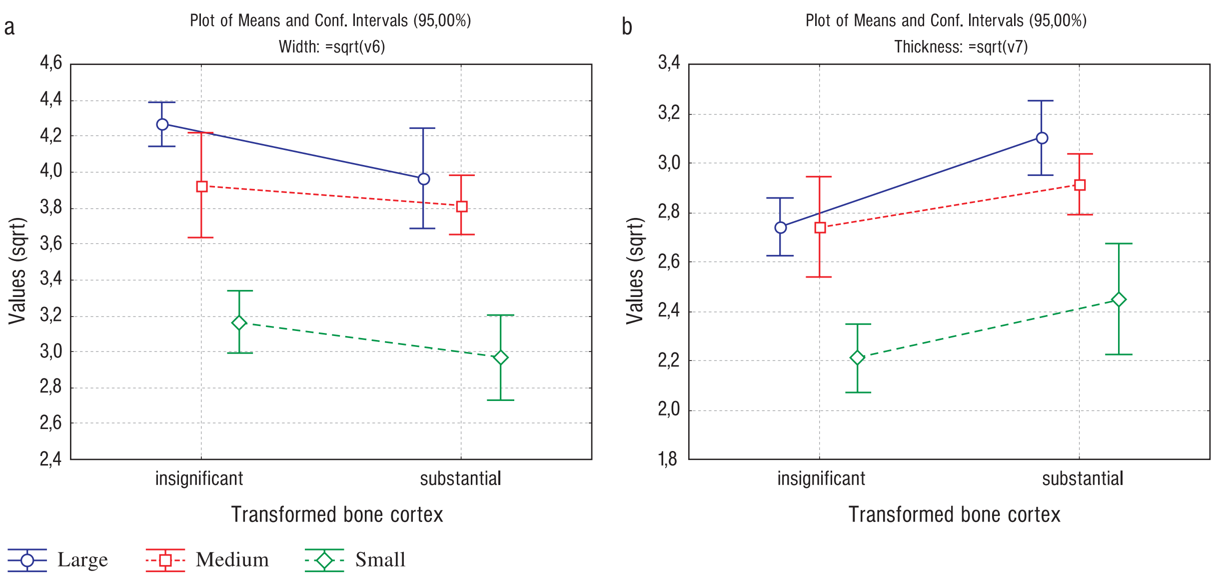


Fig. 10.3: Result of the analysis of variance (One-way ANOVA, p < 0.001) pertaining to the bone cortex transformation of the large, medium-sized and small points from P. z. according to (**a**) width and (**b**) thickness (total n = 78; particular n = 15 – large insignificant transformation, 10 – large substantial transformation, 11 – medium-sized insignificant transformation, 18 – medium-sized substantial transformation, 16 – small insignificant transformation, 8 – small substantial transformation).
Sl.10.3: Rezultat analize variance (One-way ANOVA, p < 0,001) preoblikovanja kostne lupine pri velikih, srednjih in majhnih konicah iz P. z. glede na (**a**) širino in (**b**) debelino (skupni n = 78; delni n = 15 – velike, neznatno preoblikovane, 10 – velike, znatno preoblikovane, 11 – srednje, neznatno preoblikovane, 18 – srednje, znatno preoblikovane, 16 – majhne, neznatno preoblikovane, 8 – majhne, znatno preoblikovane).

in the large blanks so as to obtain a reliable and effective weapon.

The large and small points with substantial cortex transformation are significantly narrower and thicker that the large and small points with insignificant cortex transformation (*Fig. 10.3a,b*). The large points with insignificant cortex transformation are significantly wider that the medium-sized points with insignificant cortex transformation (*Fig. 10.3a*). The absence of a significant difference in their thickness (*Fig. 10.3b*) indicates repairs of damaged large points. These repairs did not involve substantial work on the faces, but rather on the edges, which resulted in narrower points. The large points with substantial cortex transformation are significantly thicker than medium-sized points with substantial cortex transformation (*Fig. 10.3b*). The absence of a significant difference in their width (*Fig. 10.3a*) indicates either the absence of repairs or the repairs resulting in a thinner rather than a narrower point. The former does not correspond with some of our interpretations, the latter is not logical. Hence it is the use of the cortex transformation criterion for identifying repaired points that is questionable. Contrary to expectations, the medium-sized points do not include significantly more examples (χ^2 test: $p = 0.10$) with substantial cortex transformation (18 : 11) than the large points (10 : 15). In contrast, there are significantly less small points (χ^2 test: $p = 0.03$) with substantial cortex transformation (8 : 16) compared with the medium-sized points (18 : 11).

Verpoorte (2012) used the difference in the fragmentation of points from the entrance area and from the back of P. z. to suggest that the Palaeolithic visitors repaired the damaged points at the entrance and stored them for later use at the back. This interpretation is problematic for several reasons, some of which have already been mentioned above. Another compelling reason is that the lithic assemblage from P. z. include no pieces that could be used as tools for rough planing, for example large cores (planes) with a blunt angle of the working edge that would produce long facets such as occur on the edges of some points. Various authors (Moreau et al. 2015; Jéquier 2016; Doyon 2017) do no mention these facets even though they should, especially in connection with the *chaîne opératoire* in the manufacture of individual points or points in general. There are rare large flakes (and blades) with a sharp angle of the cutting edge which are suitable for fine turning, but without the nibbling retouch that occurs during scraping. Such atypical tools quickly become worn during point manufacture and need replacing. The used tools are usually discarded on the spot. We can infer from the quantity of points, the absence of suitable atypical lithic tools and the absence of typical macroscopic damage on the tools that points were manufactured or repaired at P. z. only exceptionally. We cannot hope to find evidence of manufacture and repair in production waste (chips, shavings) because such small pieces are not archaeologically recognisable. It would be possible to unearth unused blanks as the result of the above-suggested technique of splitting bone and antler. If the manufacture took place elsewhere, the blanks could also be made from the bones of animals other than predominantly cave bears. For very long flat points, they could be gained from the metapodials of horses, elks, giant deer and red deer. People usually split the metapodials to get to the marrow; they could also gain suitable blanks for points at the same time.

Almost all points were brought into the cave complete, used for hunting in or near the cave and damaged during this activity. As for why they remained in the cave, it is difficult to answer this question with sound arguments. The hypothesis that they were ritually deposited in the cave functioning as a sanctuary (Odar 2008, 2015) is not supported by scientifically sufficient arguments. It is possible that at least some of the damaged points were stored there as spare parts, while others, still unused, were lost either during the dangerous pursuit of hunting hibernating cave bears or during stays in the poorly lit back of the cave. The unusable broken pieces of points were most likely discarded.

While the distal part of the points is consistently smoothed, the basal part in most cases is left rough, which indicates they functioned as the passive end of the point. The base of all the points regardless of their shape is either rounded or pointed, which suggests that, firstly, the hafting manner depended on whether the base was wide and rounded or narrow and pointed, and secondly, that it did not change through time, hence that it was effective and practical. However, we have noticed a technical problem in hafting the spindle-shaped points with an oval cross section of the base, which would be solved by inserting the point into the soft pith of an elder shaft (Horusitzky 2006, 348). This hafting manner may apply to at least 27 points from P. z. (*App. 2,* Column 6, numbers in bold), which would have been used as light javelins or arrowheads.

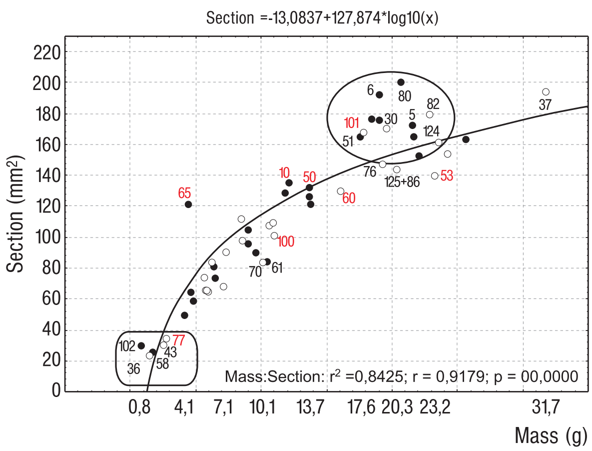


Fig. 10.4: Relationship between mass and maximum cross section of the well preserved flat (rings) and spindle-shaped points (dots) from P. z. The presumably repeatedly repaired points are in an oval frame and the presumed arrowheads in a rectangular frame. The undamaged points are shown in red inventory numbers, other in black (total n = 52; partial n = 26 – spindle-shaped, 26 – flat).

Sl. 10.4: Odnos med maso in največjim presekom dobro ohranjenih ploščatih (krogi) in vretenastih konic (pike) iz P. z. V ovalu so domnevno večkrat popravljene konice. V pravokotniku so domnevne puščične osti. Inventarne številke celih konic so rdeče, ostalih črne (skupni n = 52; delni n = 26 – vretenaste, 26 – ploščate).

The points that Horusitzky (2006, 337) identified as such are too wide to fit into the cavity of an elder stick. A good solution may be seen in the shouldered spindle-shaped point No. 38 (Brodar, Brodar 1983, Pl. 16: 38) (*Fig. 12.3:* 38). It would have been difficult to securely haft oval-sectioned points in the split or cut of the shaft in any other manner. Moreover, the cut in the shaft was the weakest point of the armature. It would also have been very difficult to make a central cut with the tools available at the time, but fairly easy to make a lateral cut. It was impossible to hollow out the shaft in the length of the point base. Neither is a foreshaft made from a long bone a suitable solution to the hafting problem of spearheads because the opening is too large for a point and too narrow for a shaft. The find of a point fragment wedged in the medullary cavity led S. and M. Brodar (1983, Fig. 56) to suggest that points were also hafted in medullary cavity of long bones, but this argument is not convincing. It was probably merely a coincidental find, as similar examples are known from Divje babe I with the only difference that the medullary cavity there held unworked bone fragments. The depicted point fragment is broken off at a much lower spot that the edge of a simple bone shaft. It is difficult to say why a point would break so deep in the shaft and not at the edge. Having said that, S. and M. Brodar came very close to the solution of the hafting problem – points hafted into the pith of an elder stick.

As already stated, it was essential for a point as a hunting tool to be durable and effective. The strength of a point is two-dimensionally determined in a satisfactory manner with its mass and the product of maximum width and thickness (hereinafter cross section) at the shaft-point junction, as shown in *Fig. 10.4*. The diagram only includes the points damaged less than 11% of reconstructed total length. The relationship between cross section and mass is curved (logarithmic function) as the values of both variables are limited up with the maximum possible thickness and width of the bone blanks and with the optimal width with regards to the penetrating effect. Both variables are in a strong and very significant linear relationship (r = 0.91, p < 0.001), but also in a non-linear one

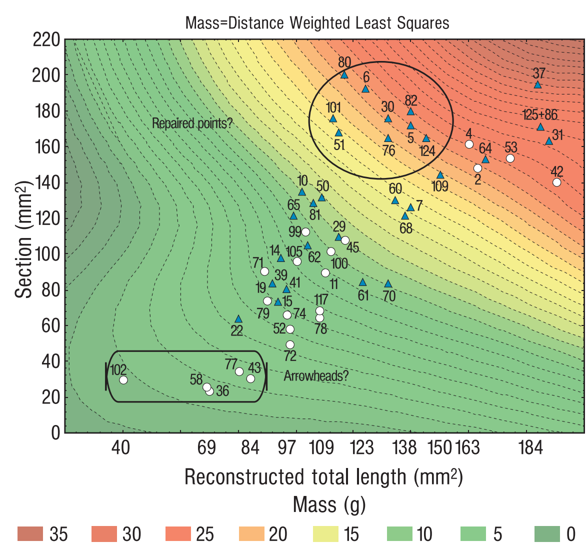


Fig. 10.5: 3D diagram showing the relationship between the reconstructed total length of the almost complete points from P. z., their cross section and mass. The presumably repeatedly repaired points are marked with triangles. The points most likely repeatedly repaired are in an oval frame, the presumed arrowheads in a rectangular frame (total n = 52; partial n = 30 – repaired points, 22 – unrepaired points).

Sl. 10.5: 3D-diagram s prikazom odnosa med rekonstruirano celotno dolžino skoraj celih konic, njihovim presekom in maso. Navedene so inventarne številke P. z. S polnimi trikotniki so označene domnevno večkrat popravljene konice. Najznačilnejši primerki so obkroženi. Domnevne puščične osti so v pravokotnem okvirčku (skupni n = 52; delni n = 30 – popravljene konice, 22 – nepopravljene konice).

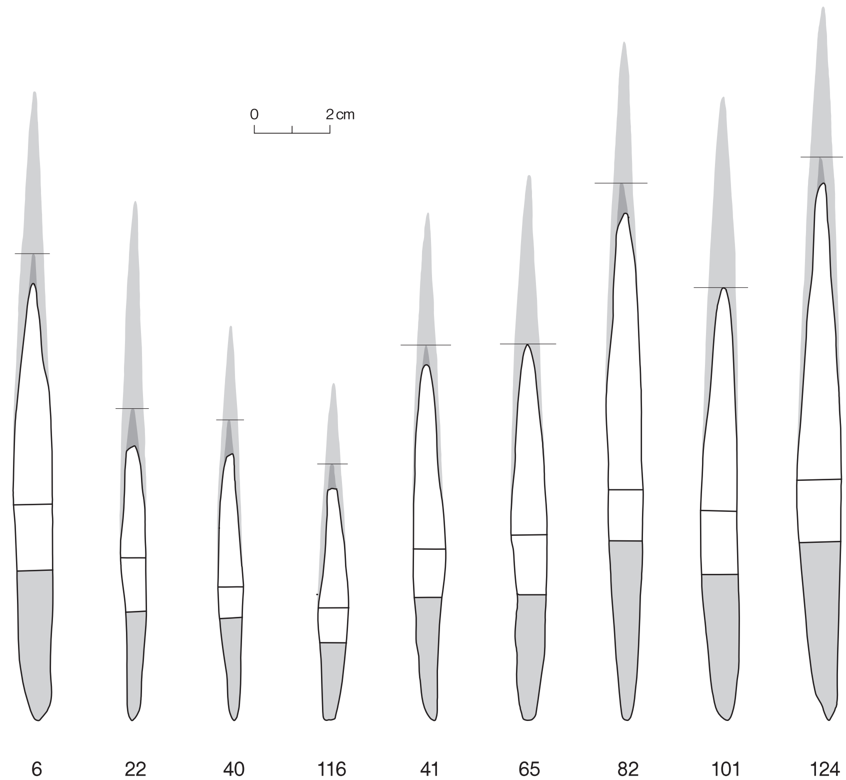


Fig. 10.6: The spindle-shaped points Nos. 6, 22, 40, 41, 65, 82, 101, 116, 124 and the flat point No. 82 from P. z. with a long medial part in side view. The presumed current bases are shaded, located below maximum thickness marked with a line. Also marked with lines are the presumed previous size, apical and distal damage and base.
Sl. 10.6: Stranski pogledi vretenastih konic št. 6, 22, 40, 41, 65, 80, 101, 116, 124 in ploščate konice št. 82 z dolgim medialnim delom iz P. z. Baza (domnevno sedanje nasadišče) je v rastru. Sedanje nasadišče je pod največjo debelino konic. Posebej sta označeni domnevna nekdanja velikost in baza.

(r = ?). The relationship between select variables shows an even increase in the strength of the flat and spindle-shaped points. As mass depends on the size of a point and size is partially connected with efficiency, we decided on a 3D representation of the relationship between the reconstructed total length (maximum 11% reconstruction of the missing length), their cross section and mass. All three variables are strongly and significantly correlated (multiple R (z/xy) = 0.91, $p < 0.001$).

The 3D diagram (*Fig. 10.5*) shows mass in contour lines that are projected onto a 2D plane and fit best with the non-linear spatial presentation of the data of the three variables. The diagram reveals that the points in the oval frame are disproportionately massive and short (see *Figs. 5.2:* 76; *10.7:* 6,51; *12.3:* 30,80,101) compared with equally massive points of considerably greater length. This is illustrated by the data on the points Nos. 80 (20.7 g, 200 mm^2, 117 mm) and 64 (22.1 g, 153 mm^2, 166 mm). In its current condition, No. 80 (*Fig. 12.3:* 80) is poorly penetrable and not usable for hunting. It shows considerable transformation and bears cuts at the medial-distal border, suggesting that it should have the special status of (repeatedly ?) repaired point. It is unlikely that it ended its use as an awl. It was more likely in secondary use as the butt of a spear or a walking stick. The 3D diagram includes at least 30 points that may have been transformed due to the repairs to the distal part. The maximum thickness and thereby cross section in some (e.g. Nos. 6, 65, 80, 82, 101, 124) is shifted distally from the base (*Fig. 10.6*). Some (Nos. 51, 65, 80) only have cuts medially just above the base (*Figs. 10.7:* 51; *12.3:* 80), others (Nos. 37, 70, 129) also have cuts on the upper part of the base (*Fig. 10.7:* 129). Most (Nos. 5, 6, 30, 37, 51, 65, 70, 76, 80, 82, 101, 124), however, are disproportionally massive considering their slightly reconstructed total length (*Figs. 5.2:* 76; *10.7:* 6; *12.3:* 30,80,101). All this suggests repairs of the apical and distal damage and the shaping of a new base on large distal fragments (*Fig. 10.7*).

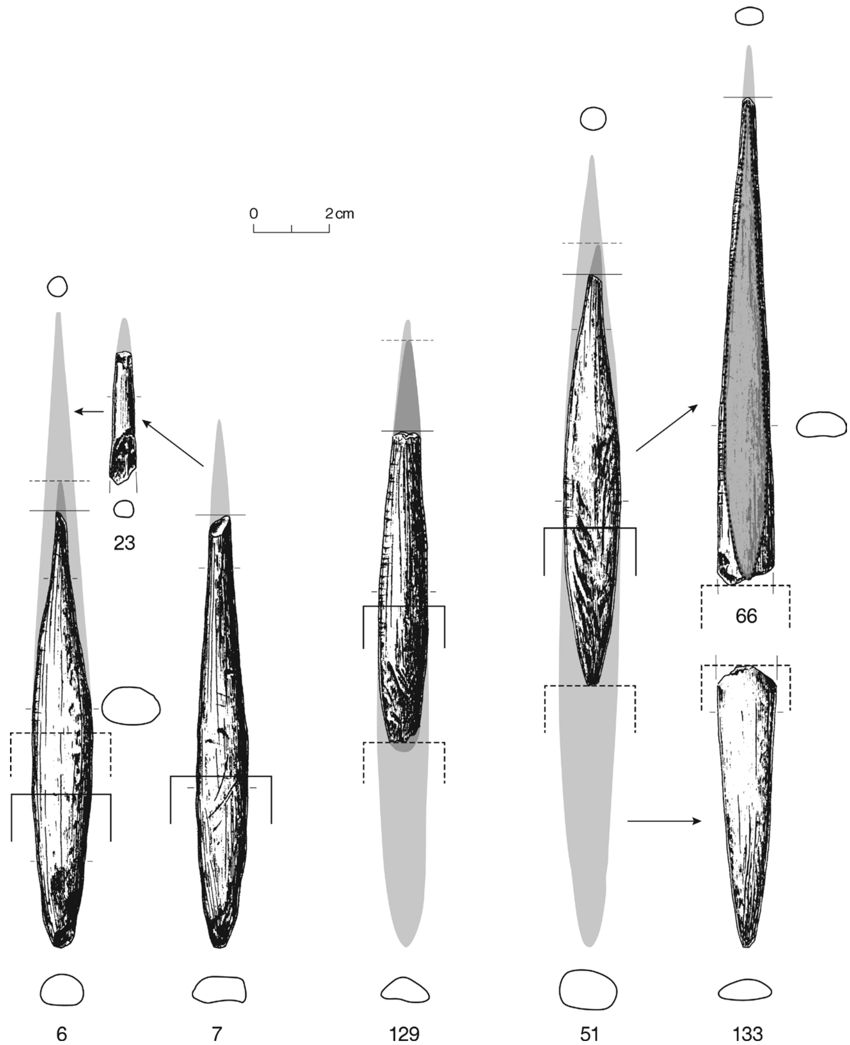


Fig. 10.7: Original size of the basal and distal parts of the presumably repaired points from P. z. based on maximum thickness or maximum cross section (No. 6), on maximum cross section and the remains of cuts next to it (No. 51) and on the unusual presence of cuts on the upper part of the base (No. 129) with added apical (No. 23), distal (No. 66) and basal fragments (No. 133). The possibly repaired point on the distal fragment No. 66 is shaded.
Sl. 10.7: Prvotne velikosti bazalnega in terminalnega dela domnevno popravljenih konic iz P. z. glede na največjo debelino oziroma največji presek (št. 6), največji presek in ostanek zarez ob njem (št. 51) in neobičajno prisotnost zarez na zgornjem delu baze (št. 129). Dodan je apikalni (št. 23), terminalni (št. 66) in bazalni odlomek (št. 133). Na terminalnem odlomku je z rastrom označena možna popravljena konica.

Very small and light points, possibly used as arrowheads, form a special group (*Fig. 10.5* rectangular frame and *10.6:* 22,40,116). They include a single point with a split base (No. 102). Odar (2008; 2015) used copies of such points in his experiments and interpreted them as arrowheads hafted into an elder foreshaft. Unless we are dealing with light javelins or awls used by women and children (see Owen 2013) – with the exception of the split-based point No. 102 that corresponds most closely to an arrowhead[17] – this interpretation is correct. If they are indeed light javelins or awls, the question is what were women and children doing in P. z. Odar (2015) also suggested that the arrowheads or small points were originally longer and became reduced in length due to repairs; there

[17] Another possibility is that they were the projectiles of a blowpipe with a tuft of hair or fibre inserted into the split (Horusitzky, pers. comm.).

is no evidence to corroborate such a hypothesis with the sole exception of the observation that maximum thickness in some points (Nos. 22, 40, 41, 72, 116) shifted away from the current base (*Fig. 10.6*).

11. DAMAGE ON THE POINTS

We performed a detailed statistical analysis of the damage on the osseous points by first dividing them into two groups based on the most significant damage sustained while hunting with a javelin, lance or arrowhead (*App. 2,* Column 19, 20). We excluded the points that may have been damaged during archaeological excavations (Nos. 13, 67, 90, 91, 93, 94, 99 and 119).

The first group (apical-distal) comprises points missing the apex (2–10% damage, n = 32) and those missing some of the distal part (11–44% damage, n = 37),[18] but still having the base. The second group (basal-distal) consists of large basal and distal parts (fragments) of points that presumably broke at the shaft-point junction (n = 24). The fractures are predominantly perpendicular to the longitudinal axis, often also oblique (Nos. 17, 91, 95, 104, 106, 121, 122). All broken distal parts are damaged at the top. What appears at first glance to be minor damage to the terminal of the base (Verpoorte 2012) most likely represents the remains of the fracture surface of the blank, in a repaired point possibly the remains of the fracture that the original point sustained when it broke at the shaft-point junction (Nos. 2, 14, 18, 19, 28, 34, 39 and others). The remains of these fracture planes mostly have sharp edges. Apical and short distal fragments are rare finds at P. z. (see Odar 2014 and caption to *Fig. 3.2* in this article). To the contrary, such fragments and large distal fragments are common at Istállóskő (e.g. Pb 50/11, Pb 50/15–19, Pb 50/24, Pb 50/60, Pb 50/93, Pb 50/161, Pb 50/165, Pb 50/167, Pb 51/13, Pb 51/85 unpublished; Vértes 1955, Pls. 34: 1; 36: 4), where antler split-based points predominate. Only rarely do such fragments occur as the consequence of excavation and are distinguishable from ancient ones in unweathered fracture planes (e.g. P. z. Nos. 13, 91, 94, 119). A challenge to interpret is the medial fragments, which are very rare (P. z. Nos. 17, 21, 24).

The edges of the fractures on the apical and distal fragments are either sharp or rounded (*App. 2,* Column 20), the fracture plane either appears unweathered or is weathered. The points with rounded edges and weathered fracture plane were undoubtedly already damaged in the past. There are 43 such points of the total number of 66 with apical and distal fractures. Rounded fracture edges do not mean that damaged points were used, as most bone fragments in the clastic cave sediments naturally get more or less rounded edges due to weathering. Rare point fragments show oblique compressive or step fracture (e.g. Nos. 3, 17, 24, 25). Experiments show that the tip of a point made of fresh bone or antler breaks in this manner if the point hits bone (Arndt, Newcomer 1986; Doyon, Knecht 2014).

A special question pertains to apical and insignificant distal damage. M. Brodar (2003) believed that such points continued to be used regardless of the damage. We are of the opinion that every damaged point was eventually re-sharpened to be functional. A very pertinent question that M. Brodar posed is why at least 60 of the damaged points were not re-sharpened. Another equally pertinent question is why were the numerous still usable points, according to Brodar, found alongside equally numerous unusable fragments. If both were stored in the cave, they could have been stored there so as to be repaired and reused at a later point (Verpoorte 2012). It is certainly easier to leave behind an unusable than a usable point.

Apical and distal damage may also have occurred either in a post-sedimentary process or during excavation. S. Brodar and later Odar (2014) unearthed few distal and apical fragments. The compressive or step fractures suggest that most damage occurred due to the stresses during use and is not post-sedimentary (see Horusitzky 2008). Moreover, it is not known that any of these fragments fitted to one of the damaged points. Seven of the points with distal compressive fracture have rounded and a single one sharp fracture edges. Of the apically damaged points (2–10% damage), 26 have rounded edges and only four sharp ones. For

[18] In the experimental use of replicas of massive-based antler points as projectiles, the points sustained a maximum of 13.4% damage when hitting bone (scapula). No fractures at the shaft-point junction have been noted (Doyon 2013, Tab. 4.5). We need to keep in mind that no lab experiment can replicate all the circumstances and consequences occurring during hunting. Repeated experiment gave the maximum damage of 17.32% or 16 mm (Doyon, Knecht 2014), which corresponds with independent observations by Horusitzky (2008). For an interpretation of how the large distal fragments occurred see Horusitzky 2008.

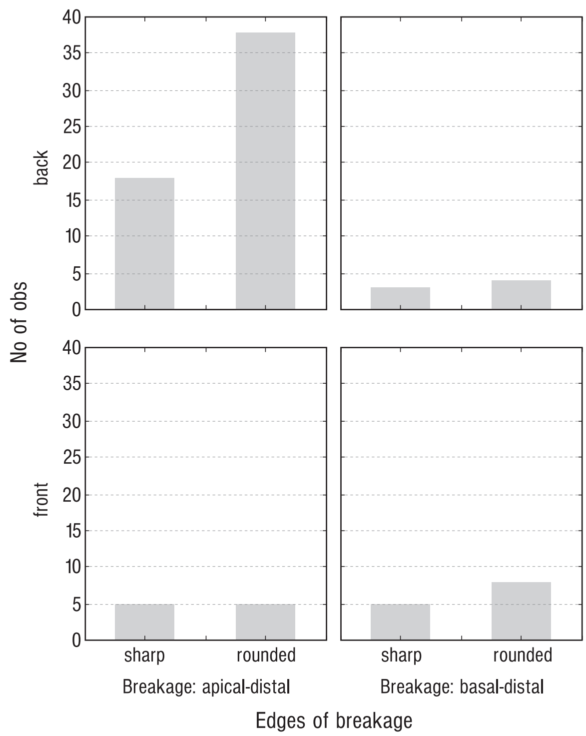


Fig. 11.1: Number of damaged points from P. z. according to cave areas and shape of the fracture plane edges (total n = 86; partial n = 56 – apical and distal damage back, 10 – apical and distal damage front, 7 – basal and distal fragments back, 13 – basal and distal fragments front).
Sl. 11.1: Zastopanost konic iz P. z. s poškodbami glede na lokacijo in obliko robov prelomnih ploskev (skupni n = 86; delni n = 56 – apikalne in terminalne poškodbe, zadaj, 10 – apikalne in terminalne poškodbe, spredaj, 7 – bazalni in terminalni deli, zadaj, 13 – bazalni in terminalni deli, spredaj).

those with more substantial damage to the distal part (11–44% damage), the number of fractures with rounded and sharp edges is almost equal (17 : 19). At least eight points were damaged during excavation, which is much more than the number stated by S. and M. Brodar (1983). All the points damaged during excavation have sharp fracture edges and unweathered fracture planes.

The fracture planes of large basal and distal point fragments have rounded edges in twelve cases and sharp edges in eight cases. A particular example is a point surviving as two corresponding fragments (Nos. 86 and 125). The two fragments were found at some distance from one another, but both at the entrance. The distal fragment has sharp edges, the basal fragment rounded ones. The edges of the basal fragment were clearly rounded in a post-sedimentary process. The same has been established for one broken cave bear humerus recovered during the excavations led by S. Brodar (Brodar, Brodar 1983, 82). An alternative interpretation suggests that the edges became rounded during reuse of the fragment as an *ad hoc* tool. In a similar way, the insignificant apical fractures may also have become rounded during continued use of the points (M. Brodar 2003). The fracture edges, be they sharp or rounded, tell us nothing definite of how and when the damage occurred, with the exception of damage during archaeological excavation.

The collection of points from P. z. includes a fragment of a longitudinally split massive base (No. 107), which is highly unusual damage. Equally unusual are two fragments of longitudinally split medial part of points (Nos. 110 and 131). Damage such as this and the gnawed broken ends of the point No. 49 (Turk et al. 2001, Fig. 20a; Moreau et al. 2015, Fig. 3: 1) could have been caused by carnivores and have nothing to do with the use

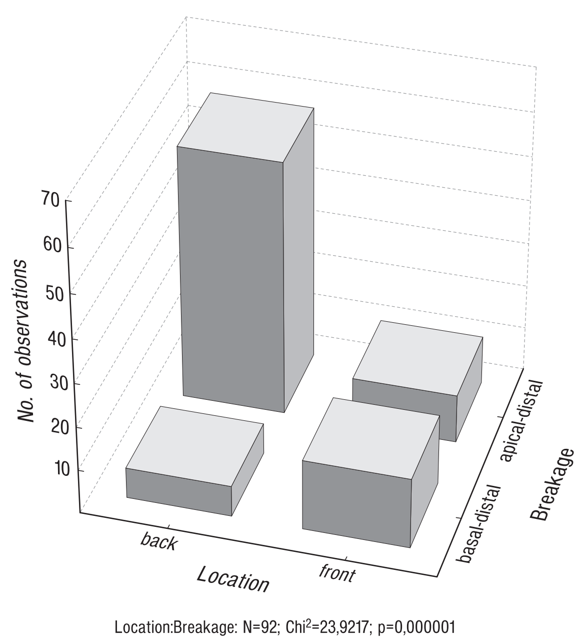


Fig. 11.2: Number of points with apical and distal damage, as well as of the basal and distal fragments of the points from P. z. according to cave areas (total n = 92; partial n = 58 – apical and distal damage back, 7 – basal and distal fragments back, 11 – apical and distal damage front, 16 – basal and distal fragments front).
Sl. 11.2: Zastopanost konic iz P. z. z apikalnimi in terminalnimi poškodbami ter odlomljenih bazalnih in terminalnih delov konic glede na lokacijo (skupni n = 92; delni n = 58 – apikalne in terminalne poškodbe, zadaj, 7 – bazalni in terminalni deli, zadaj, 11 – apikalne in terminalne poškodbe, spredaj, 16 – bazalni in terminalni deli, spredaj).

of the points or it does (see Bergman 1987, Fig. 1: 4). Similar gnaw marks have been observed on the Pr. 11 point from Dzérava skala (Slovakia). To our knowledge, no one except Bergman has as yet specifically pointed out such damage.

Two fragments of large points (Nos. 9 and 122) surviving as the distal and much of the medial part have a fracture that is not readily explainable using one of the above-presented interpretations on the cause of fractures.

We performed a statistical analysis of the damage on the points from P. z. to verify the above-mentioned interpretations.

The number of damaged points from both areas of the cave with clear differences in the texture of the sediments shows differences and similarities in the fracture plane morphology (*Fig. 11.1*). The points with apical and distal damage from the back of the cave show a strong predominance of rounded edges, while such points from the entrance area show nearly equal number of rounded and sharp edges. There are no substantial differences between the points from the two areas with regards to the shape of the edges on the basal and distal fragments. In consequence, it is difficult to make reasonable inferences on the impact of sediments on the point damage (*contra* Verpoorte 2012).

The number of damaged points shows statistically significant (χ^2 test: $p < 0.001$) differences between the two areas of P. z. (*Fig. 11.2*), while the width and thickness of the points that could influence these numbers show no significant difference. S. and M. Brodar (1983) already observed that more basal and distal fragments were found at the entrance than at the back. To the contrary, the back revealed much more apically and distally damaged points than the entrance area. Basal fragments predominate at the entrance, distal fragments at the back. There seems to be no clear evidence to support the hypothesis of either storage (Verpoorte 2012) or ritual offering of the points (Odar 2015) at the back of the cave. Apical and distal damage may, together with the recent finds of such fragments (ib.), indicate a more intensive use of points at the back. Points may have been used in the spring hunt for cave bears, for which the warm back of the cave and the niches in the huge rockfall blocks represented the ideal winter hibernation spots. Any point detached from its shaft or broken together with it was lost in such dangerous circumstances.

The two groups of damaged points significantly differ in width and reconstructed length (*Fig. 11.3*). The basal and distal parts that broke off have significantly greater reconstructed length of the distal part ($p < 0.001$) and greater width ($p = 0.001$) in comparison with the apically-distally damaged points. Their thickness shows no significant differences ($p = 0.82$). The result shows that long points frequently broke at the shaft-point junction in spite of their greater width unless the point was thickened at this spot and unless the shaft broke instead. The frequency of apical-distal damage is almost equal between flat (37 items) and spindle-shaped points (31 items). Flat points include fourteen with apical damage, spindle-shaped points include eighteen such items. There are 23 flat points with extensive distal damage and only 13 spindle-shaped points. The basal and distal fragments belong to 15 flat points and only

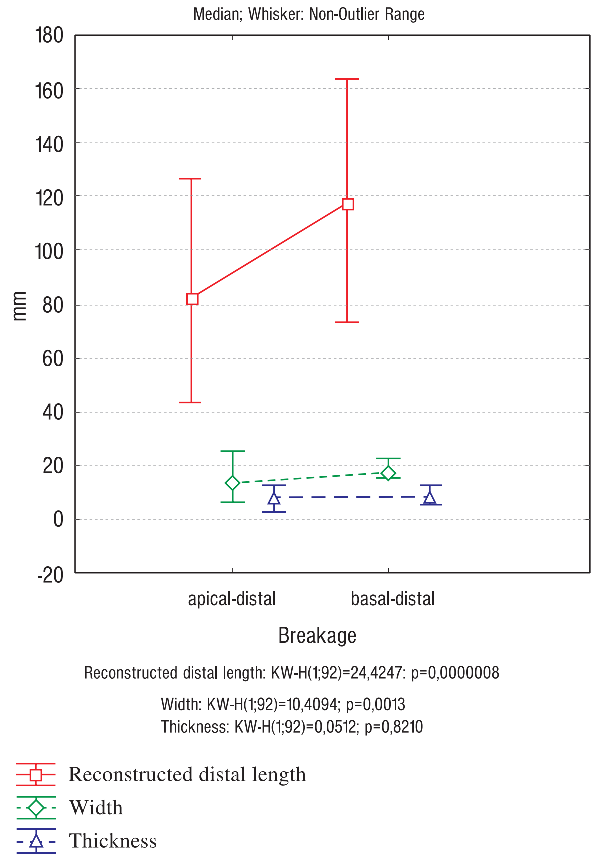
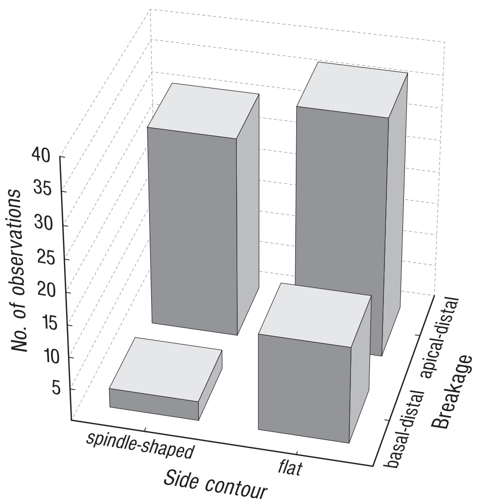
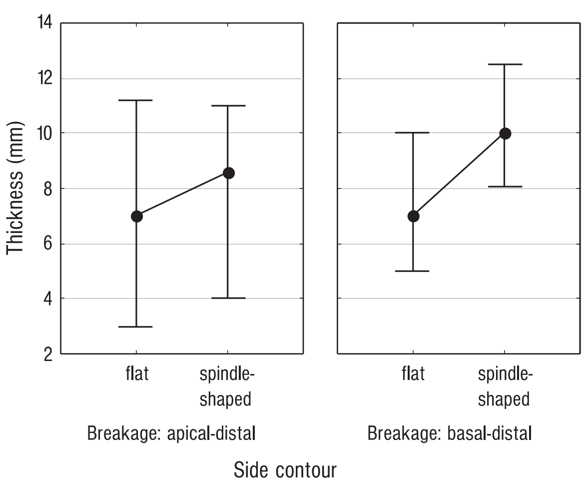


Fig. 11.3: Result of the median test for the reconstructed distal length, width and thickness of the damaged points from P. z. (total n = 92; partial n = 69 – apically and distally damaged points, 23 – basal and distal fragments).
Sl. 11.3: Rezultat testa mediane za rekonstruirano distalno dolžino, širino in debelino poškodovanih konic iz P. z. (skupni n = 92; delni n = 69 – apikalno in terminalno poškodovane konice, 23 – bazalni in terminalni deli konic).

a



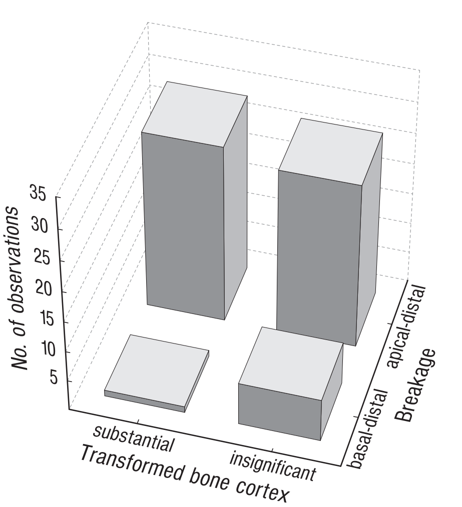
Side contour: Breakage: N = 86; Chi2 = 4,9801; p = 0,0256



Breakage: apical-distal Thickness: KW-H(1;68) = 6,8653; p = 0,0088
Breakage: basal-distal Thickness: KW-H(1;18) = 4,5996; p = 0,0320

Median Non-Outlier Range

b



Transformed bone cortex: Breakage: N=64; Chi2=4,3384; p=0,0373

3 spindle-shaped points. The latter were obviously better than flat points.

There are 22 large, 27 medium-sized and 20 small points with apical-distal damage. Of these, eight large, fifteen medium-sized and nine small points show apical damage, while fourteen large, twelve medium-sized and eleven small points show distal damage. There is no difference between the large and small points in this sense, which indicates their similar use. Basal and distal fragments only belong to large (20 items) and medium-sized points (3 items). Large points were more frequently fractured due to longer leverage, due to exposure to greater loads compared with the medium-sized and small points, or because their fragments were stored for later repair and transformation into smaller points.

One of the premises was that spindle-shaped points were more durable than flat ones. The numbers of basal and distal fragments of both point types that broke off at the shaft-point junction supports such a premise if disregarding the strength of the wooden shaft. Flat points include significantly more (χ^2 test: p = 0.02) of these fragments than spindle-shaped ones (*Fig. 11.4a*). Almost all the distal fragments are missing the apex, which is usually damaged when the point hits a hard obstacle (Horusitzky 2007; Doyon, Knecht 2014). Only three distal frag-

Fig. 11.4: Number of the spindle-shaped and flat points from P. z. with apical and distal damage, as well as of the basal and distal fragments of both point types (total n = 86; partial n = 37 – flat apical and distal damage, 15 – flat basal and distal fragments, 31 – spindle-shaped apical and distal damage, 3 – spindle-shaped basal and distal fragments) (**a**). Number of points with apical and distal damage, as well as the basal and distal fragments according to the degree of bone cortex transformation (total n = 64; partial n = 27 insignificant apical and distal damage, 7 – insignificant basal and distal fragments, 29 – substantial apical and distal damage, 1 – substantial basal and distal fragments) (**b**).

Sl. 11.4: Zastopanost vretenastih in ploščatih konic iz P.z. z apikalnimi in terminalnimi poškodbami ter odlomljenih bazalnih in terminalnih delov prvih in drugih konic (skupni n = 86; delni n = 37 – ploščata, apikalne in terminalne poškodbe, 15 – ploščata, bazalni in terminalni deli, 31 – vretenasta, apikalne in terminalne poškodbe, 3 – vretenasta, bazalni in terminalni deli) (**a**). Zastopanost konic z apikalnimi in terminalnimi poškodbami ter odlomljenih bazalnih in terminalnih delov konic glede na preoblikovanje kostne lupine (skupni n = 64; delni n = 27 neznatna apikalne in terminalne poškodbe, 7 – neznatna, bazalni in terminalni deli, 29 – znatna, apikalne in terminalne poškodbe, 1 – znatna, bazalni in terminalni deli) (**b**).

ments (Nos. 13, 16 and 96) show no damage to the apex, indicating that the fracture occurred due to flexion rather than impact (Horusitzky 2008). Two of the fragments belong to flat and one possibly to spindle-shaped points. These three points may have formed part of lances, which are less likely to suffer apical damage. In the number of points with apical and distal damage, flat points only have a minor advantage over spindle-shaped points. This is expected, as both types are nearly equally resistant in this part. The basal and distal fragments of the spindle-shaped points that broke off are significantly thicker ($p = 0.03$) than the same fragments of the flat points; similarly for the apically and distally damaged points ($p < 0.01$). Other measures show no significant differences.

The number of damaged flat and spindle-shaped points corresponds with the number of those with bone cortex transformation (*Fig. 11.4b*). The points with insignificant cortex transformation include significantly more (χ^2 test: $p = 0.03$) basal and distal fragments than the points with substantial cortex transformation. The opposite is true of apical and distal damage. It can be expected that a greater amount of work put into the manufacture of a point results in its higher quality.

The analysis of point fragmentation has revealed that almost exclusively large points of a certain width and even more of certain thickness broke in the lower medial part. They are flat points manufactured with relatively little effort. Small points show a different damage pattern, but are no less damaged. The similar and equally heavy apical-distal damage of large and small points suggests their similar use. Both large and small points can have distal compressive fractures (e.g. Nos. 3 and 25), which is damage typically sustained by javelin and arrowheads when hitting a hard obstacle. Fractures on the (lower) medial part are mainly caused by lateral stress such as occurs when thrusting with a lance or when the shaft of a planted javelin moves to and fro in reaction to impact (see Horusitzky 2008). These fractures are typical of flat points that may have been used as lanceheads. As no small points show medial fractures, we infer that these were not used as lanceheads. The smallest points may have been used by women and young individuals, hafted onto light javelins, or by all members of a community as arrowheads. As the presence of weaker members of Aurignacian communities is questionable at P. z. given its high altitude, it is more likely that the small points were used as arrowheads.

12. DISCUSSION

Scholars have determined the types of Aurignacian points in an arbitrary fashion, based on the performance of the base (massive, split), shape of the face (lozenge-shaped, spindle-shaped, triangular) and cross section (oval, plano-convex, rectangular and others). This was a generally accepted practice joined by certain measures (also used in this article) and measure ratios in the form of quotients (see e.g. Doyon 2013; 2017). The latter is unnecessary as it only repeats the findings obtainable from basic measures. On the incentive of F. Z. Horusitzky, we added the shape of the side contour as a defining characteristic directly linked to the point's technical properties similarly as the performance of the base and shape of the face. The contour criterion allowed us to distinguish between flat and spindle-shaped points (*Fig. 3.1*). The typometrics have confirmed the validity of such a division, to which several site monotypes should be added (Nos. 5, 49, 55, 60, 92, 97, 103) that cannot be analysed statistically. Monotypes are coincidental shapes of points that either proved not functional to the Aurignacian hunters, stand at the beginning of new, more successful lines of points or are merely imitations of points of other technological traditions.

The size data for individual points from sites that yielded comparable numbers of points only recently became available, enabling us to correctly perform a comparative statistical analysis with the points from P. z. The necessary data in part come from Doyon's dissertation (2017, Annexe 2) that brings together the basic measures for 322 split-based and 225 massive-based points from 49 Aurignacian sites in Europe. His list is unfortunately not complete. For Istállóskő, for example, it only gives 23 of the total of roughly 130 points that are, admittedly, in a heavily fragmented state. It includes 52 points (*App. 3*) of the total number of 117 from our own list of points from P. z., leaving out the most representative and best preserved examples (Nos. 4, 5, 30, 31, 41, 42, 53, 60, 61, 64, 68, 70, 75, 76, 92, 100, 101, 109, 124). Those left out include almost all the small points (Nos. 25, 36, 40, 43, 52, 57–59, 69, 72, 77, 102, 116) that were on exhibition at the time and therefore unavailable for Doyon's measurements. Because of the analytical concept, he also intentionally left out all basal and distal fragments without at least the remains of the medial part. Doyon used a different definition of the basal and distal parts and his measures for these

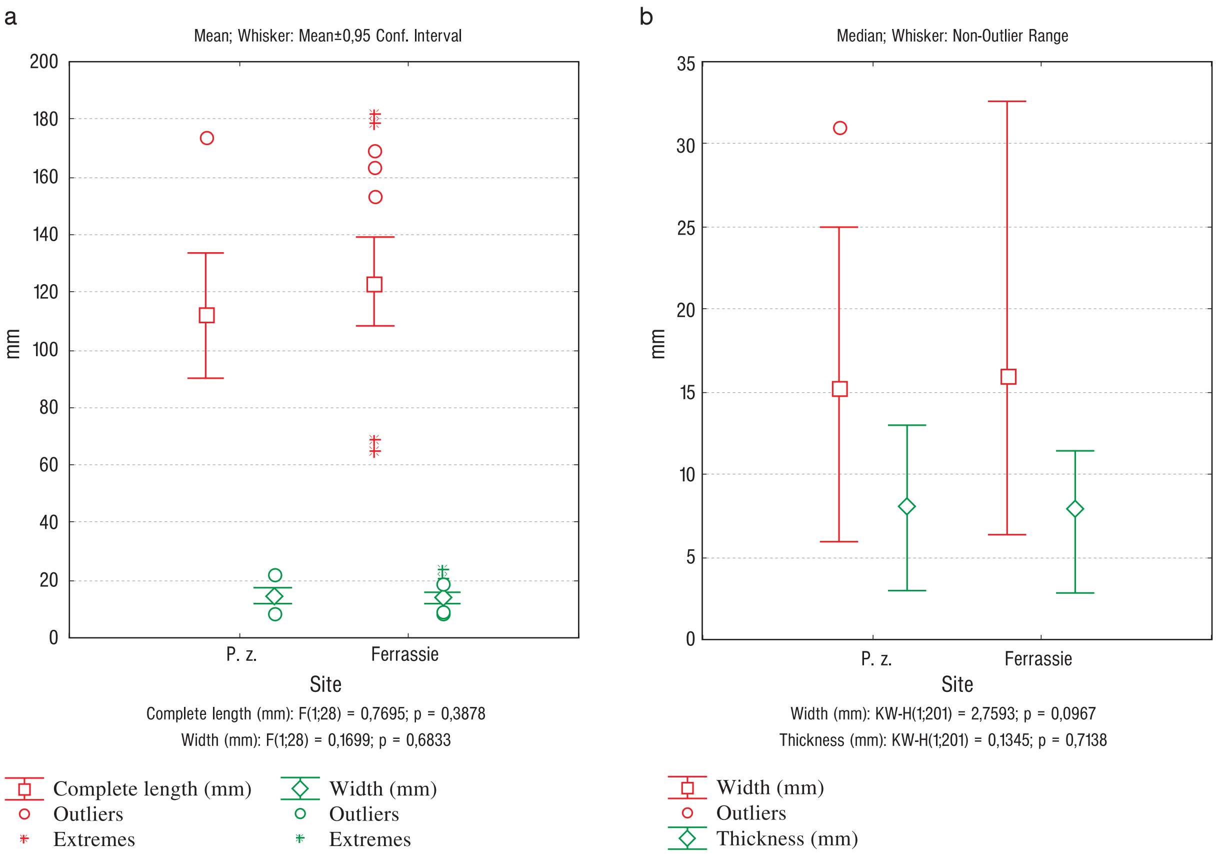


Fig. 12.1: Comparison of the normally distributed measures of the length and width of the complete points from P. z. (n = 9) and La Ferrassie (n = 21) (**a**), as well as the width and thickness of enlarged samples from both sites (P. z., n = 117; La Ferrassie, n = 84) (**b**).
Sl. 12.1: Primerjava normalno porazdeljenih mer dolžine in širine celih konic iz P. z. (n = 9) in La Ferrassie (n = 21) (**a**) ter širine in debeline razširjenega vzorca z obeh najdišč (P. z., n = 117; La Ferrassie, n = 84) (**b**).

two key elements cannot be compared with ours, making a comprehensive comparative analysis of variance between the points from P. z. and those from Doyon's list impossible.

Doyon (2017, Tab. 5.1) provides the descriptive statistics for the length, width and thickness of the split-based points predominantly from French sites and made almost exclusively from reindeer antler. For 62 complete points, he gives the length of 43.5–168.7 mm, the mean value of 81.1 mm, the standard deviation of 25.9 mm and the median of 78.1 mm, which is considerably less than the statistics for the length of complete points and the reconstructed lengths of the points from P. z. (*App. 2*). For 316 points, he gives the width of 6.1–40.1 mm, the mean value of 14.8 mm, the standard deviation of 5.4 and the median of 13.8 mm, as well as the thickness of 3–13.4 mm, the mean value of 6.3 mm, the median of 6.2 mm and the standard deviation of 1.6 mm. The statistics for the width correspond with those for the points from P. z., not so the statistics for thickness, where the points from P. z. show higher values. The data for the maximum thickness of split-based points (13.4 mm) given by Doyon (ib.), as well as Tartar and White (2013) are surprising, as they exceed the thickness of the antler compact tissue for individual deer species. Such thickness can only be obtained together with the spongy tissue, which is present on almost all of the antler points (Doyon, Knecht 2014). The split-based points from Istállóskő are 18–6 mm wide and 3.2–6.2 mm thick (Dobosi 2002; unpublished data by Horusitzky).

The only site apart from P. z. that yielded large number of massive-based points is La Ferrassie (France). A comparison of the lengths of complete massive-based points between P. z. and La Ferrassie shows no statistically significant differences (*Fig. 12.1a; App. 1*). For 48 complete massive-based points (eleven from P. z., almost all others from La Ferrassie), Doyon (2017, Tab. 5.1) gives the length of 40–245 mm, the mean value of 126.7

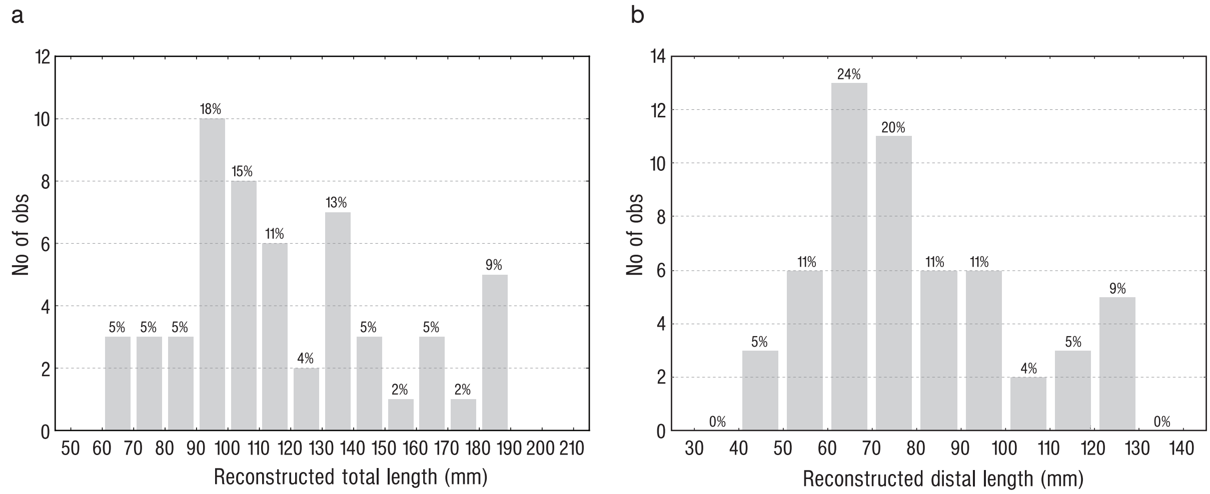


Fig. 12.2: Distribution of the reconstructed total length (0–11%) (**a**) and the reconstructed distal length of 55 points from P. z. (**b**).
Sl. 12.2: Porazdelitev celotne rekonstruirane dolžine (0–11 %) (**a**) in rekonstruirane terminalne dolžine 55 konic iz P. z. (**b**).

mm, the standard deviation of 47.9 mm and the median of 109.8 mm. He does not distinguish between points according to the shape of the face and side contour, but rather according to the shape (geometry) of the base. For the lozenge-shaped points (*pointes losangiques*) from French sites, Leroy-Prost (1975, 118) states the lengths of <50–221 mm with an average of 148 mm. The spindle-shaped massive-based points (*pointes fusiformes*) are 84–121 mm long (ib., 121), while the triangular points (*pointes triangulaires*) reach the length of up to 300 mm (ib., 115). Many of the triangular points may actually be the distal parts of the massive- or split-based points that broke at the shaft-point junction, such as are also present (e.g. Nos. 13, 16, 47) in the P. z. collection (*Fig. 3.5*). With only few exceptions, the points of all shapes are made of reindeer antler (Doyon 2017, Annexe 2). At Istállóskő, only rare massive-based points have been recovered (Pb 50/90, Pb 50/91, Pb 50/2, Pb 507133, Pb 50/187, Pb 50/188; Vértes 1955, Pl. 41: 1,2); the only completely preserved, slender massive-based Pb 50/91 point is 253 mm long (Vértes 1955, Pl. XLI: 1; Dobosi 2002, 90, Fig. 7: 1).

The length data for points from different sites from Hungary to France (Istállóskő, Dzeravá skala, Mladeč, Wildhaus, Badelhöhle, Fumane, Les Rois, Mallaetes), including P. z. (see Brodar, Brodar 1983, Pl. 10: 49), show that there were long points, but also very long points of different shapes and different base types (massive, split). This is certainly to be expected for hunting weapons and considering the frequent finds of the remains of hunted animals the size of deer or horse. Long and more or less slender points had a functional advantage over other points, but also required more effort during manufacture (long blanks were more difficult to obtain given the properties of the raw material) and they were more prone to breaking at the shaft-point junction than shorter ones of equal width and thickness.

The varied lengths of the points lead to the question of the purpose of such a wide range. Why would people need the points of so many different lengths for hunting? Were they initially around 250 mm long and gradually became shorter due to repairs? Or were the lengths adapted to the hunted animal species and to different members of their communities, be it adult men, women, elders, children? If the latter were the case, what were all these members doing in the alpine environment of P. z.? The scarce remains of the presumed prey speak against a varied range of hunted species that would require points of different lengths. Did people deposit the points, after they had served their purpose and were reshaped, in a special place with the intention never to use them again? Were the small and some medium-sized points used in hunting at all? The lack of a clear distinction in thickness and partially width between large and medium-sized points, as well as the gradual increase/decrease of the lengths shows that the situation, at least for P. z., may in part be the consequence of repairs to the damaged apical and distal parts that occurred during use. No more can be said at this stage.

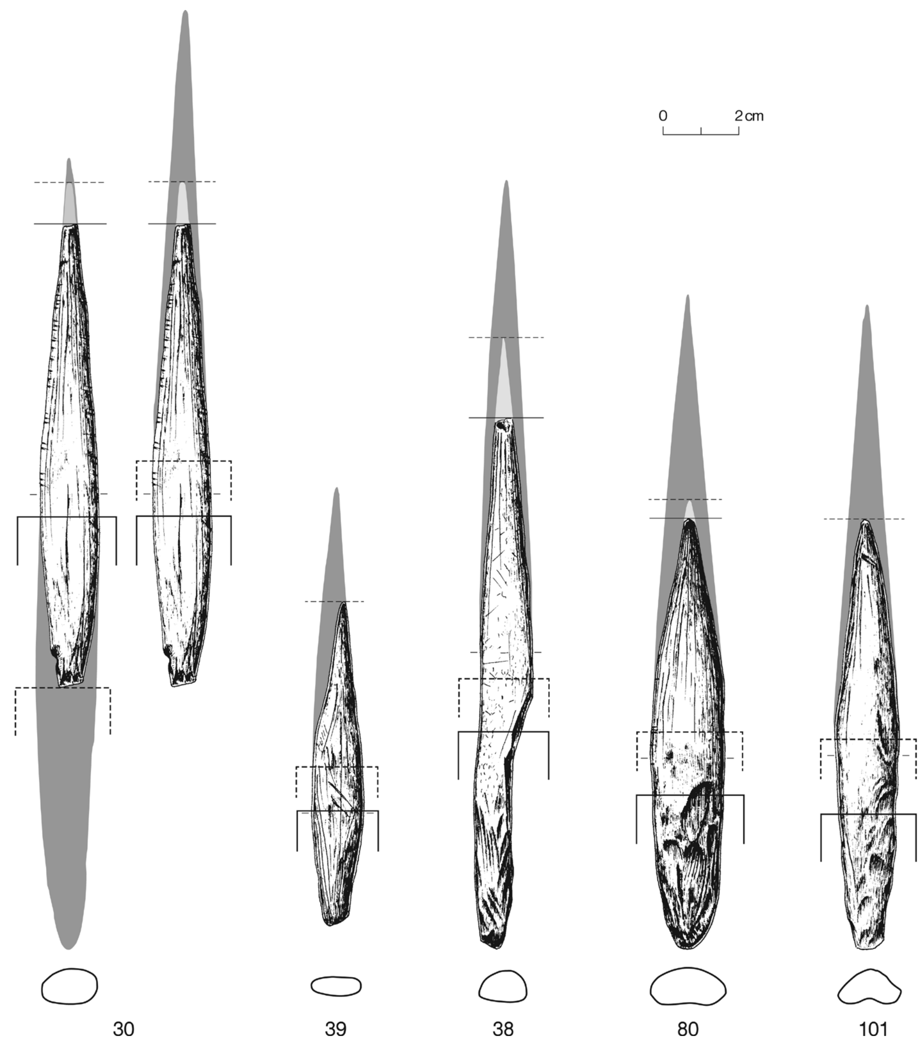


Fig. 12.3: Presumably repaired points from P. z. with their current and previous base and distal part (Nos. 30, 38, 39, 80, 101).
Sl. 12.3: Primerki domnevno popravljenih konic iz P. z., njihova sedanja in nekdanja baza ter terminalni del (št. 30, 38, 39, 80, 101).

The wide range of sizes has also been observed at the rare other sites that yielded numerous points. It is therefore reasonable to wonder whether the same phenomenon, of repairing damaged large points, also took place elsewhere. The 75 complete split-based points from different French sites show the following length distribution: less than 50 mm (10.6%), 50–100 mm (57.3%), 100–150 mm (29.3%), more than 150 mm (2.06%) (Leroy-Prost 1975, 109). Most of the complete split-based points from Abri Castanet are 50–69 mm long (Tartar, White 2013, Fig. 5). At P. z., points twice as long (100–120 mm) predominate among the complete ones. P. z. yielded significantly more points in the 100–150 mm (48% of all points) and more than 150 mm (18% of all points) class than the French split-based points from different sites (29.3% and 2.06%).[19] It is not certain that it was viable/possible to once more split the base of originally split-base points usually damaged at the base and therefore render them usable again. It would rather be logical to rework such points into massive-based points.

The 25 complete lozenge-shaped massive-based points from Abri Blanchard des Roches show the following length distribution: 90–110 mm (5 items), 110–130 mm (3 items), 130–150 mm (7 items), 150–170 mm (4 items), 170–190 mm (1 item), 190–210 mm (4 items) and 210–230 mm (1 item) (ib., 116). A comparison with the size of the almost complete points from P. z. shows that

[19] Comparing the sample of points from a single site with a composite sample of points from several sites can give a misleading result.

P. z. yielded no points more than 190 mm long, but as much as 15% that measure 60–90 mm, hence are shorter that the French lozenge-shaped points. The differences hinder us from establishing whether the lozenge-shaped points are also the result of repairs.

More important than the total length (*Fig. 12.2a*) is the length of the active distal part of a point (*Fig. 12.2b*). Of the points from P. z., 14% measure 110–130 mm in this part, which must have sufficed for hunting game to the size of roe deer, possibly hind. We suppose that the number of points with such distal parts was originally higher. Most points (44%) have a 60–80 mm long distal part, which is suitable for hunting small game. It is difficult to establish whether these were originally long points repaired several times or were designed to be of this size at the start. Individual already mentioned examples certainly point to repairs of damaged points, but cannot be used as evidence of a general practice of repairs. More solid evidence to this effect can be gained from some statistical indicators given in the analytical part of the contribution. An indicator of repairs to the spindle-shaped points may be the frequent location of maximum thickness in medium-sized points above the current base or well above one third of the point length (*Figs. 10.7:* 6; *12.3:* 38,80,101). This spot may mark the border of the hafted base before repairs to the distal part. Doyon (2013, 2017) used the ratio between the lengths of the distal and basal parts as the criterion for possible repairs; the point was highly likely repaired if the two parts are equally long. He based this on the supposition that the base length remained constant because the points were repaired when still hafted. This makes no sense for substantial repairs. It is more plausible that the length of the base changed proportionately with the length of the point as a whole, which means that the point needed to be re-hafted after several minor or every substantial repair. This maintained the effectiveness of the distal part. For the most evident candidates for repaired points, we came to the same conclusions as Doyon even though working with different premises and criteria for identifying repaired points.

We were not able to find thickness data for the lozenge- and spindle-shaped massive-based points from individual French sites. Doyon (2017, Appendix 2) does state the length, width and thickness of massive-based points, but without distinguishing between spindle- and lozenge-shaped. Knecht (2000) only gives width: for thirty spindle-shaped points that of 7–19 mm and for 101 lozenge-shaped points the width of 5–33 mm. Most spindle-shaped points measure 10–15 mm in width, most lozenge-shaped ones measure 15–20 mm (ib.). This is similar as at P. z., where most spindle-shaped points (n = 10) are 12–14 mm wide and most flat ones (n = 17) are 16–18 mm wide (*Fig. 12.4a*). The lozenge-shaped points from La Ferrassie are clearly wider than the spindle-shaped ones (Doyon, Knecht 2014, Fig. 1). In parallel, the flat points from P. z. may be wider than the spindle-shaped ones (*Figs. 4.1* and *6.2*). We presume that the spindle-shaped points from La Ferrassie are thicker and narrower than the lozenge-shaped ones, similarly as those from P. z. The unstratified samples of points from both sites do not differ statistically in width and thickness (*Fig. 12.1a,b; App. 1*). To the contrary, the massive-based points are clearly wider and thicker that the split-based ones (see Doyon 2017, Fig. 5.4 and 5.5), which is reasonable in evolutionary sense and corresponds with the presumed chronological attribution of both basic types of points or their bases, as well as its spread in space and time (ib., Fig. 6.4 and 6.5). The split-based points from Istállóskő are on average 11 mm wide and 4.7 mm thick. This is less than the average width (15 mm) and thickness (7.7 mm) of the points from P. z. (*App. 2*), which also differ from the split- and massive-based points from other sites in their maximum thickness and width that lies roughly at 1/3 of the length for mechano-technical reasons. Greater average thickness of the points from P. z. – particularly the spindle-shaped ones – shows that most were made of bone and only a small proportion possibly of deer antler. Empirical analyses have shown the latter to be the most suitable material for manufacturing split-based points (Albrecht 1977; Knecht 2000; Tartar, White 2013), but also for making blanks for points with the innovative technique presented above. The thinner compact tissue of reindeer antler (5 to 7 mm) (Tartar, White 2013) in comparison with the bone compact tissue of cave bears (≥ 10 mm) made it unsuitable for the manufacture of large spindle-shaped points. Moreover, reindeer remains are very scarce at the Palaeolithic sites in Slovenia. The same is true of the whole eastern Alpine region (Pacher 2003) and Italy (Tagliacozzo et al. 2013), where there is even a complete absence of these remains in the Aurignacian and just before it. The visitors to P. z. would have had to go to great lengths to acquire this raw material in contrast

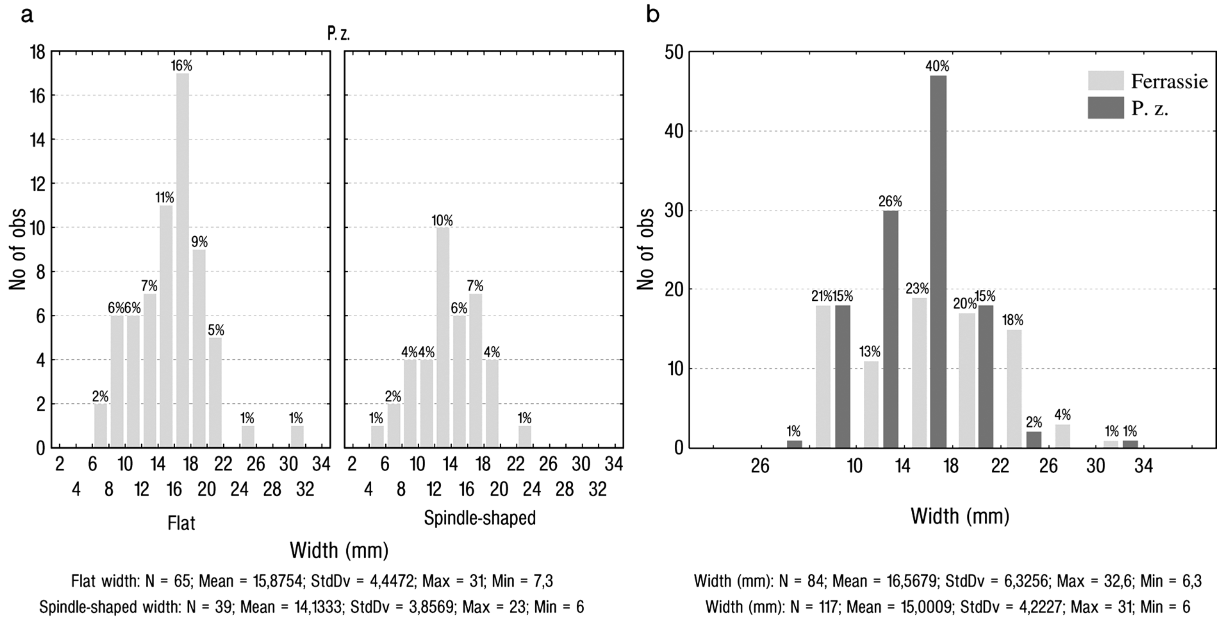


Fig. 12.4: Distribution of the width of the flat and spindle-shaped points from P. z. (**a**) and of the massive-based points from P. z. and La Ferrassie (**b**).
Sl. 12.4: Porazdelitev širine ploščatih in vretenastih konic iz P. z. (**a**) in konic z masivno bazo iz P. z. in La Ferrassie (**b**).

with the Aurignacians in France, where there was an abundance of reindeer in the migration season. The most readily available raw material was red deer antler with a coarser surface that demanded a specific splitting technique to obtain suitable blanks, similarly as bone.

The Palaeolithic hunters must have realised that width, thickness and their position with regards to the shaft have an important impact on the mechanical properties of their points; they gradually combined all these properties in an optimal manner. Past studies have not taken this fact in consideration seriously enough when discussing the evolutionary-technical improvements that must have been made when correcting the shortcomings exposed during use.

Based on the greater length and thickness of the massive-based points from P. z. – for the spindle-shaped ones also on the smaller width – we suggest that they were more effective than the split-based points, although this has not yet been experimentally corroborated. We correlate greater efficiency with bone as raw material instead of antler and with technological improvements linked to the hafting manner and measures taken to reduce breakage.

The difference between a massive and a split base was clearly also a difference in the hafting manner. The shape of the split base shows that the hafted part could not have covered 1/3 of the point's length, but considerably less, which meant that the point may have rapidly gotten loose during use. It was also twice as likely to break at the split than had the split not have been made (Horusitzky 2004). The points with a massive base narrower and thinner than 10 mm were presumably hafted into a hollow elder stick up to 2 m long. Well suited for this hafting manner were the lozenge-shaped points of *module A* from French sites. They had a drawback, however, in that the distal part was short in comparison with the length of the haft if judging from the point's maximum width shifted distally across the half-length of the point. An improvement in the sense of the points from P. z is *module B* of the lozenge-shaped points, where maximum width is shifted towards the base. Standing halfway between the two is *module C*, where maximum width lies at mid-length. Their shape and the length of the distal part made most lozenge-shaped points of these three modules less effective and lagging far behind the technically advanced and more efficient spindle-shaped points from P. z. Closest to the latter were the medially thickened spindle-shaped points (also called *biconiques*), but these are extremely rare finds at French sites and only measure up to 120 mm (Leroy-Prost 1975, 121). One example presumably of such a shape, measuring 135 cm in length, was found in P. z. (No. 5, removed from the collection during German occupation in WW II and later returned) (*Fig. 3.1*) The narrow spindle-shaped points thickened at one third of the length from the terminal of the base were best suited of all Aurignacian points for hafting into a naturally hollow shaft (see Knecht 2000, who suggested an artificially hollowed shaft).

In his discussion on Potočka zijalka and Mokriška jama, M. Brodar (1985a, also see M. Brodar 1985b; 2009) published and explained three diagrams with the measures of 83 points from P. z. as evidence of these points belonging to a single, though rather variable type. He thus lent additional support to his suggestion to replace the name *Mladeč point*, originally proposed by Bayer after the Mladeč site and also used for the points from P. z. (Bayer 1922; 1929), with that of the *Olševa* or *Potočka zijalka point* (Brodar, Brodar 1983). He defined it formally and metrically as a bilaterally symmetric massive-based point with the basal part covering 34.5%, the medial part 13.0% and the distal part 52.5% of its length (Brodar, Brodar 1983, 127f). Until recently, the points from P. z. were generally, but as it turns out erroneously believed to have belonged to a single type, i.e. massive-based *Mladeč point*. Horusitzky (2004) was the first who distinguished between two types: flat and spindle-shaped. These metrically only differ in thickness (*Fig. 12.5*). It should be emphasised that thickness only increases in a statistically significant manner ($p > 0.05$) proportionately with width in small and medium-sized points, both flat ($r = 0.84$ and 0.54), and spindle-shaped ($r = 0.67$ and 0.72). More differences between flat and spindle-shaped points were gained from the analysis of variance.

Doyon (2017) went even further, distinguishing between seven morphotypes of massive-based points from P. z., of which only M04 is clearly recognisable (a single point, No. 56: Doyon 2017, Fig. 6.2). This morphotype, primarily determined on the geometric characteristics of the base, include the large point from Mladeč (which gave the name to the type) and three smaller ones from the same site, six from Vindija and three from La Ferrassie (ib., Annexe 2), but none of the massive-based points from Dzérava skala (ib., Annexe 2, his Nos. 3273–3275) with close parallels from P. z. (see Horusitzky 2008; Turk 2014). Doyon's morphotypology corresponds with the opinion of M. Brodar that the points from P. z. are not of the *Mladeč type* according to Bayer (1922).[20] The drawback of Doyon's division is that all morphotypes of the points from P. z. comprise both flat and spindle-shaped points (*App. 3*) in spite of the fact that the volume of points was considered in the classification. The morphotypological division of points is thus flawed, particularly because the main criterion is limited to the base. It is possible to distinguish between rounded and pointed bases, the latter characteristic of spindle-shaped points and particularly well suited for hafting into the hollow pith of elder sticks.

The morphotypes determined on the basis of a group of sites with massive-based points seem of little use in terms of the practical use of the points from the perspective of P. z., which undermines the methodology that Doyon proposes for analysing the split- and massive-based points. Doyon also failed to explain the purpose of the uncharacteristically different contours (he calls it geometry) of the massive base and the possible advantages of such shapes in hafting and use of the points. We can only speak of advantages of one shape over the other in the case of split or massive base, with the latter having an advantage over the former. Interestingly, the bases of the split- and massive-based points are quite similar, at least in terms of either a rounded or pointed terminal (see Doyon 2017, Figs. 6.1 and 6.2). This gives the impression that the flat points are all roughly of the same shape (design) and experiments mainly pertained to the hafting manner.

Doyon identified S03 (= proto-Aurignacian and Aurignacian I) as the earliest morphotype of split-based points, represented in almost all French sites, while the example outside France and geographically closest to Slovenia came to light at Šandalja (ib., 252, 254, Fig. 6.1: S03). One such point that Doyon did not include in his S03 has also been found at P. z. (No. 102, currently on exhibition), which is very similar to the point from Šandalja (Turk 2014, Fig. 10.12). No. 102 was unearthed in Layer 5 Front (Brodar, Brodar 1983, Pl. 9: 102). It is stratigraphically contemporaneous with Doyon's morphotypes M02 and M05 (Layer 5 Front), and also later than M02, M03, M05 and M07 (Layer 7 Front) (Doyon 2017, Annexe 2). In this case, we trust stratigraphy over morphometrics for chronological attribution, particularly because of the relatively thick sterile Layer 6 separating the two layers. Another similar point (No. Pb 51/24, unavailable, on permanent exhibition) was found at Istállóskő (Vértes 1955, Pl. 34: 11; Dobosi 2002, 91).

[20] On this subject also see Horusitzky 2008, 233–234.

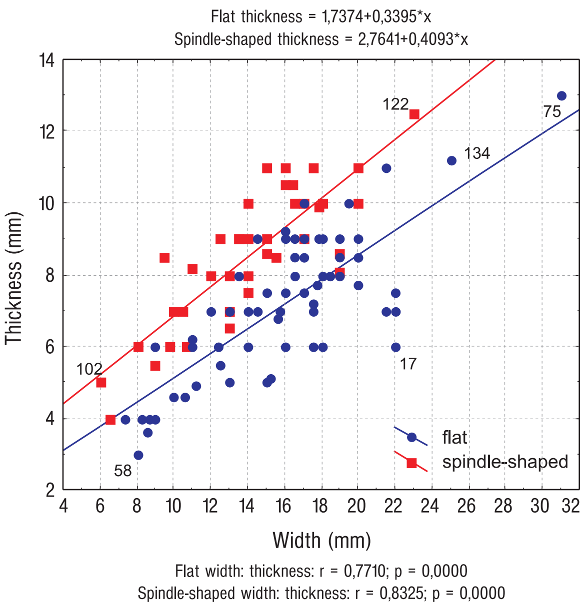


Fig. 12.5: Relationship between the width and thickness of the flat and spindle-shaped points from P. z. (total n = 104; partial n = 65 – flat, 39 – spindle-shaped). Some of the points with outlying measures are marked with inventory numbers.
Sl. 12.5: Odnos med širino in debelino ploščatih in vretenastih konic iz P. z. (skupni n = 104; delni n = 65 – ploščate, 39 – vretenaste). Številke označujejo nekatere konice s skrajnimi merami.

According to Doyon, the most numerously represented morphotype at P. z. is M02 (n = 24 or 45%). It is represented with sixteen points (18%) at La Ferrassie. The problem is that, like all other Doyon's morphotypes at P. z., it comprises both flat (n = 13 or 25%) and spindle-shaped points (n = 10 or 19%). Doyon thus equated the points from P. z. with those from La Ferrassie, but this is not plausible as their overall designs are completely different and there is a further difference in how the point was strengthened at the shaft-point junction. Doyon's second most numerous morphotype at P. z. is M01 (n = 11 or 21%), comprising ten (19%) flat and one (~2%) spindle-shaped points. It is represented at La Ferrassie with 28 (32%) points. The third is M05 (Doyon 2017, Fig. 6.2: left P. z., right La Ferrassie) with four (~8%) flat, three (~6%) spindle-shaped and one undeterminable point (~2%). There are fourteen (16%) points of this morphotype at La Ferrassie. The fourth is M07 with one flat (~2%) and three spindle-shaped (~6%) points. At La Ferrassie, it is represented with eight (9%) points. Points of morphotypes M02, M03 and M07 were also found at Dzérava skala (one of each), a site that yielded formal parallels for the points from P. z. (Horusitzky 2008), while two examples of M02 were found at Mladeč. Istállóskő yielded points of different morphotypes than P. z., but these do include at least two massive-based examples (Pb 50/51, 50/90; Vértes 1955, Pl. 41.1) formally close to the points from P. z. (in Horusitzky's opinion).

Finally, we should make certain remarks regarding the denomination of the points as suggested by M. Brodar. The name *Olševa* or *Potočka zijalka type point* instead of the *Mladeč point* is only appropriate for the points with a spindle-shaped side contour, a pointed massive base and a variable length of the medial and distal parts (*Fig. 3.1:* 50). The edges are rounded, in very rare cases one edge is sharpened (No. 74). As much as 66% of all points are thickest in their widest part (Brodar, Brodar 1983, 126; M. Brodar 2009, 274), i.e. at their weak spot at the top of the base or in the medial part if they have it. This, but also the frequent presence of cuts on blunt edges[21] and the elaborate design clearly differentiates them from the lozenge-shaped and also the spindle-shaped points from the French sites at Abri Blanchard des Roches, La Ferrassie and Abri Castanet, which are widest (and thickest?) at mid-length (Leroy-Prost 1975, 121f; 1979, 277, 281; Knecht 2000), but also from almost all of the points from the Hungarian site at Istállóskő (Dobosi 2002). The medial part enabled several repairs of the apex without altering the 1:2 ratio between the length of the base and that of the active part (Turk 2002). The repairs potentially shortened some of the points and caused the medial part to gradually become one with the base, i.e. the hafted part. Points with these characteristics and properties only come from a stratified sequence in a high enough number at P. z. (ib.). S. and M. Brodar (1983, 125) state 84 such points (roughly 2/3 of the whole collection), while our sample includes 65 flat and only 39 spindle-shaped such points. The two authors did not distinguish the spindle-shaped points, which are certainly a special feature of P. z., from the widely used flat points. The proposed complementary definition of the *Potočka zijalka type point* is consistent with the definition of the ideal *Potočka zijalka type point* according to S. and M. Brodar (1983, 128) and with the last comprehensive description that M. Brodar offered for the points from P. z. (2009, 274f, Pls. 20–22) accompanied by illustrations that

[21] Only rare split-based and triangular points have sharp edges (see Leroy-Prost 1975).

present almost exclusively spindle-shaped points. It is a variant of massive-based points advanced in design and technique that is numerically superior to any other Aurignacian site.[22] For that reason, P. z. can justifiably be determined as their type site.

The numerous flat points with a spear-shaped face and a massive, either rounded or pointed base in the P. z. sample could be, broadly speaking, of the *Mladeč type* (*Fig. 3.1*: 53); a single point (No. 56) corresponds best with to this type (Brodar, Brodar 1983, Pl. 13). The *Mladeč type* cannot be equated with the *Potočka zijalka type* according to the definition proposed above (also see Horusitzky 2008; Doyon 2017; 2019). M. Brodar's claim (1985a; 1985b) that the P. z. sample consists of a single type of points was based on a deficient methodology. His proposition to replace the name *Mladeč point* with that of *Potočka zijalka point* is not valid for the widely used flat points with a lance-shaped face and blunt edges sometimes bearing cuts. The large point from the eponymous Mladeč site is likely a monotype and as such a poor choice for the name of the osseous points of a certain shape (Turk 2002; M. Brodar 2009, 335; Horusitzky 2008). There is a similar problem in naming the *Mokriška type point* after M. Brodar (1985a; 1985b), which is characteristically flattened and stands apart from the points of the P. z. sample in greater width and lesser thickness.

13. CONCLUSIONS

The statistical analysis of the stratified sample of Aurignacian points from P. z. has revealed several previously less known characteristics related to typology, evolutionary trends and technology. It has confirmed, in a methodologically more suitable manner, what has already been known on their measures and provided additional evidence in support of a special type of osseous points named the *Potočka zijalka point*.

The comparison of our results with those of other authors who used different analytical approaches has shown that there are more questions pertaining to the points from P. z. than there are convincingly argued answers. The same questions can have different answers, depending on how we tackle them. In this contribution, we have tackled the questions of manufacture, use and maintenance of points in a manner not employed before and established the following.

The spindle-shaped points thickest roughly at one third of their length are a special type of points for which M. Brodar suggested the name the *Potočka zijalka point*. He did, however, ascribe all the points from P. z. to this type.

The different sizes of points are the result of repairs to damaged pieces. Points thus became smaller and less useful at least for hunting large animals. The frequent finds of large game remains at Aurignacian sites and individual examples of 200–250 mm long points show that there may have been many more such weapons in use than what survives today. The cause of the surviving small numbers may lie in the repairs and the fact that such long points were more valuable than others and were cared for accordingly. It was not possible to obtain blanks longer than 230 mm from cave bear bones. It has not yet been explained how they obtained such long blanks. Their manufacture must have been quite challenging, particularly if made of bone. Some of the thick medium-sized points may have originally been very long points that broke off at the apex and at the shaft-point junction. The base was then discarded as unusable (*Figs. 3.4 and 3.5*), while the distal part was given a new base and re-sharpened, thus made into a medium-sized point (*Fig. 10.7:* 66). There is no compelling evidence of manufacture and repair at the site. This poses the question of why the people visiting P. z. left behind the differently damaged points together with the more or less complete ones.

It is generally accepted that the points of bone and antler, similarly as the lithic points, were hafted onto shafts and used for hunting as lances and javelins. Because of the differences in the properties of the different materials and consequently different shapes, effects, possibilities of repair and lifespan, they could have been used in a complementary fashion. It would therefore be useful to aim future research at comparatively and functionally analysing the length of the points from bone and antler, as well as lithic points and the remains of hunting prey with regards to the size of animals at individual sites, with the intention of explaining the unusually great variability of the

[22] Knecht (2000) only states 30 spindle-shaped points from French sites in comparison with 101 lozenge-shaped ones. If the ratio between the former and the latter (1: 3,4), by disregarding triangular points, is compared with the ratio between the spindle-shaped and flat points from P. z. (1: 1,7), P. z. is revealed as the site with by far the highest number of recovered spindle-shaped points.

lengths of antler and bone points. The suitably long osseous points could penetrate internal organs and kill or at least paralyse the prey. This was not possible with stone points; a mortally wounded animal could run away before dying and had to be tracked down. Hence osseous points represent advancement in hunting weapons. They did need to be long enough to achieve this. We should take into account all other advantages and drawbacks of osseous versus lithic points. Lithic points were manufactured quicker, but also got damaged beyond repair quicker. It was more difficult to securely haft them. Hafting required more work in comparison with some of the osseous points that were simply pushed into the soft pith of elder sticks. Because the manufacture of osseous points required considerably more effort and time compared with the lithic ones, it also makes sense that osseous points would be repaired, particularly as their size and shape allowed it.

S. and M. Brodar (1983), as well as later authors observed differences in the condition of the points from different areas of the P. z. cave and connected them to the differences in the use of space and types of activities taking place there. In spite of the many recovered fragments, only two could be joined into a complete point (Nos. 86 and 125) (*Fig. 3.4*). There are also significant and previously undetected differences between the points from the entrance and the back of the cave in their size, more precisely the length of the distal part. The dark back of the cave yielded all size classes of points in fairly even numbers regardless of type, though medium-sized points predominate. In contrast, the entrance area shows a distinctly uneven distribution of point sizes, with large points twice as numerous as medium-sized ones and only a handful of small points. The situation at the back may be the result of intentional storage of unused points and distal fragments intended to be reworked into medium-sized points. Certain as yet unexplained metric differences between the two areas were also established for the spindle-shaped and even more so the flat points.

The analysis of the stratigraphic position only provided results as expected in terms of technological advancement in a limited measure. It is a question that even S. and M. Brodar (1983) before us left unanswered. The reason may lie in a poor temporal resolution between the points from individual layers, particularly those from the back. The low numbers of points in some of the layers, which are far below the minimum required units for a statistical analysis, may also seriously blur the results. We would need more points from clearly distinguishable layers or Palaeolithic levels. The analysis has shown that a larger sample could offer results that make sense in terms of point evolution. Evolution took place through technical improvements that eventually led to an optimal rod-shaped point, such as No. 92. In the course of the Upper Palaeolithic, they probably arrived at this shape via a coincidental shape of points, such as No. 105, that performed better in all aspects compared with other points in regular use at the time. It would naturally have taken time for the new shape to replace the old ones.

The frequent cuts on the edges of points and the rare incisions on their faces are considered a feature particular to the points from P. z., but do occur, albeit rarely, on the points from other Aurignacian sites. At P. z., they are present on just over one third of all points, which is much more than at any other site. Cuts can be found on both spindle-shaped and flat points of all sizes, least on small and most on spindle-shaped points. They are most common on the strongest and most durable, flat points. Of all the different interpretations of cuts, we tend towards the opinion that the hunter made them to symbolically mark those points that proved most reliable during hunting regardless of their type. It may not be a coincidence that none are to be found on complete, unused or insufficiently tested points with the exception of No. 65. The incisions on the faces have been commonly interpreted as decoration, but may also have had a symbolic significance as indicated by those found on the surface of the medullary cavity that can have no practical value in terms of point manufacture (*Fig. 2.1*). The rare decorative (?) features related to cuts and incisions are always located on the left edge and on the medullar side of the bone cortex. The results of the statistical analysis show cuts to be an important and as yet poorly studied feature of the osseous points from P. z.

The points from the sites that yielded comparable numbers of points than P. z. survive in a much poorer condition. This is particularly true of the points from Istállóskő, which we personally examined and also drew. Based on the publications, the impression is that the points from comparable French sites show a less elaborate manufacture in comparison with the points from P. z., though we lack the data to perform a comparative analysis and objectively evaluate their condition and the elaboration of manufacture.

The damage on the points from P. z. can tell us something of their use. We were able to exclude post-sedimentary processes as the cause of the damage. It is difficult to explain a repeating breakage pattern on the same spot of the point using post-sedimentary damage and only two of the multitude of fragments that belong to the same point. An additional difficulty is the distribution of the point fragments in the two areas of the cave. This led scholars to interpret the basal and distal fragments in relation to different activities in different areas, the repairs of lances or javelins and primarily storage of damaged, but repairable points (Brodar, Brodar 1983; Verpoorte 2012). The types of damage show that large points were subjected to greater stress than the medium-sized or small points. Because of greater leverage, it is mainly they that broke at the shaft-point junction, resulting in basal and distal fragments. When the shaft was strong enough, it was the flat points that broke more often at the point-shaft junction than spindle-shaped ones; in the case of the latter it is the shaft that broke more often than the points.

The large and small points were used in the same manner, either as projectiles such as javelins or arrows or as thrusting weapons such as lances. Projectile use mainly pertains to spindle-shaped points. Some of the medium-sized spindle-shaped points were shaped so as to be readily and effectively hafted into the soft pith of an elder stick that served as a highly durable shaft to light lances and javelins, or as the foreshaft of arrowheads, i.e. small points. The use of elder would also enable quick and easy replacement of a damaged point. The large flat points may also have been used as lanceheads. Learning from the damage that the points sustained during hunting enabled the hunters to gradually come to the technically elaborate *Potočka zijalka type point*.

The division between split- and massive-based points has been generally accepted. All but one of the points from P. z. are massive-based. The shape of the basal face is more or less the same on both types. A massive base reduced the base's sensitivity to stress and in certain cases enabled simple and effective hafting in the soft pith of an elder shaft. The points were strengthened at the shaft-point junction in a way that least affected the penetrative force of their active part, which was achieved by thickening that increased the strength twice more than widening. This is why the older flat contours of wide points were then joined by the spindle-shaped contours of narrow points and the basal split, a weak spot, was abandoned. The split- and massive-based points only differ in the hafting manner and how they were strengthened at the shaft-point junction, by either widening or thickening.

What remains unexplained is the origin and significance of the rounded or pointed bases on the two basic types of points (Doyon 2019). In these shapes of bases, the force from point to shaft acts more or less pointwise. In hafting spindle-shaped points with a massive base, which could not be hafted into an elder shaft because of their width, the rounded or pointed base was more a problem than a benefit, as it increased the possibility of lateral movement together with the convexity of the base.

The statistical analysis of the points from P. z. clearly shows that there are multiple and more or less convincing answers to the frequently posed questions. We believe that one-way solutions not accompanied by in-depth and comprehensive analyses of the finds are not well thought through (see Odar 2011 and archery). We also do not agree with overly complex statistical analyses that do not provide simple, transparent and meaningful results with regards to the hafting manner and mechanical properties (see Doyon 2017; 2019 and his morphotypes determined on the basis of the shape of the base on the massive-based points, some of which include both flat and spindle-shaped points from P. z. that required different hafting methods and have different mechanical properties – *App. 3*). Hypotheses that cannot be verified either experimentally or analytically are inappropriate (see Odar 2015 and the sanctuary of Palaeolithic hunters).

The results of our analyses and their interpretation largely depend on carefully selected and arbitrarily determined factors representing qualitative traits such as size, shape, degree of bone cortex transformation, type of damage and others. This leaves open possibilities for further studies based on differently determined factors. The contribution also does not discuss all the possibilities that statistical programmes have to offer. The analyses that were performed could be repeated on standardised samples of points (see Turk 2002; 2005; Brodar 2003). It would also be useful to use the method of multidimensional scaling (see Turk 2014). A good knowledge of the properties of the P. z. sample, a respect for the scientific standards and ethics that dictate comprehensive publications of all information relating to a research are prerequisites for the confidence in the accuracy of an archaeological interpretation, but not also its correctness.

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Orinjasjenske koščene konice iz Potočke zijalke. Razlaga novih rezultatov morfometrične statistične analize

Povzetek

Članek posvečava spominu na Srečka in Mitjo Brodarja, ki sta nam zapustila dragoceno zbirko paleolitskih najdb iz Potočke zijalke.

V jami Potočki zijalki (1650 m) (odslej P. z.) je bilo pri izkopavanjih v letih 1926–1928 (M. Brodar 1994), 1928–1935 (Brodar, Brodar 1983) in 1997–2000 (M. Brodar 2000; Pacher, Pohar, Rabeder 2004) ter reviziji manjšega dela deponije S. Brodarja leta 2012 (Odar 2014) najdenih največ dobro ohranjenih, predvsem koščenih konic z masivno bazo (Brodar, Brodar 1983; Pacher 2010; Doyon 2017) iz obdobja orinjasjena v Evropi. Glavnina, 127 konic (vse, razen ene, imajo masivno bazo), je prišla na dan med izkopavanji Srečka Brodarja v letih 1928–1935. Primerljivo število precej slabše ohranjenih konic orinjasjenske starosti z masivno ali razcepljeno bazo, skoraj izključno iz rogovja jelenjadi, imajo samo naslednja najdišča: Istállóskő na Madžarskem (Dobosi 2002) ter Abri Blanchard des Roches, La Ferrassie in Abri Castanet v Franciji (Leroy-Prost 1979; Doyon 2017).

Zbirko P. z., ki trenutno šteje 135 konic, je najtemeljiteje sistematično obdelal Mitja Brodar na podlagi opisne metode (Brodar, Brodar 1983; M. Brodar 1985a; 1985b; 2009). Iz različnih pogledov so jo obravnavali in navajali tudi številni drugi avtorji (Bayer 1929; Albrecht, Hahn, Torke 1972; Hahn 1988; Turk 2002; 2005; 2014; Horusitzky 2006; Odar 2008; 2011; Pacher 2010; Verpoorte 2012; Jéquier 2016; Doyon 2017; 2019). Šest konic je bilo doslej direktno datiranih z metodo AMS ^{14}C (Rabeder, Pohar 2004; Moreau et al. 2015).

Vzorec konic iz P. z. je zaradi velikega števila dobro ohranjenih primerkov, najdenih v dveh arheoloških nivojih v dveh delih jame z različnimi bivalnimi razmerami (Brodar, Brodar 1983) in možnostmi za statistično stratifikacijo, nadvse primeren za celovito statistično obdelavo. Zato sva se avtorja pričujočega članka odločila nadaljevati začeto analitsko delo drugega avtorja (Turk 2002; 2005; 2014) in celoten vzorec sistematično proučiti in razložiti z uporabo standardnih opisnih in analitskih statistik, kamor sodi tudi analiza variance (ANOVA). Pri tem je treba poudariti, da nihče od naštetih avtorjev ni vsestransko statistično analiziral vseh konic P. z. in da je analitsko statistiko za Ivanom Turkom (2002; 2005; 2014) uporabil samo še Luc Doyon (2017; 2019).

Glavni cilj raziskave je bil odkriti in pojasniti značilnosti vzorca konic P. z., ki so povezane z izdelavo, uporabo, vzdrževanjem in morebitno hrambo konic. Zanimali so naju predvsem dejavniki, ki so vplivali na razvoj konic kot lovskega orožja, ki se je uporabljalo v obdobju več tisoč let trajajočega orinjasjena. Pri tem naj bi ključno vlogo odigrali trdnost (zanesljivost) in prebojnost (učinkovitost) konic, kot splošno priznani lastnosti (Doyon, Knecht 2014). Oboje je nedvomno tesno povezano z obliko, ki je osnova za tipologijo. Za učinkovito rabo konic je poleg oblike pomembna še velikost, ki mora biti prilagojena velikosti plena, pa tudi napadalni ali obrambni vlogi.

Številni primerljivi terminalni in bazalni odlomki (*sl. 3.4* in *3.5*) nakazujejo, da so se dobro nasajene konice pri obremenitvi rade odlomile ob toporišču (Brodar, Brodar 1983; M. Brodar 2009, 340; Horusitzky 2008).[1] Zato je bilo smiselno ta del ojačati in prenesti poškodbo na kopjišče, ki ga je bilo lažje popraviti kot konico. To je bilo mogoče doseči s šiitvijo in/ali odebelitvijo trupa konice. Vendar je bilo treba pri tem paziti, da se ni preveč zmanjšalo prebojnosti terminalnega dela konice. Domnevne, bolj ali manj vzporedne, razvojne smernice konic, povezane z njihovo uporabo, so bile zato sledeče:

– 1. Konice so se debelile in ožile ter tako postale hkrati trdnejše in prebojnejše.

– 2. Konice so se širile in tanjšale ter tako postale hkrati prebojnejše in manj trdne.

– 3. Konice so se širile in debelile ter tako postale trdnejše, vendar manj prebojne.

Za vse najdbe konic z raznih najdišč je značilno, da so konice bolj ali manj poškodovane. Za statistično analizo je bilo zato treba rekonstruirati osnovne dolžinske mere: prvotno dolžino konice, njenega nasajenega dela (baze) in aktivnega (terminalnega) dela (*pril. 2; sl. 5.1*). Oba dela lahko vključujeta medialni del, če ga konica ima. Medialni del je objektivno težko razmejiti od bazalnega in terminalnega dela. Z njim se je posebej ukvarjal I. Turk (2002). Baza, kot ključni analitski podatek, je bila arbitrarno določena tako, da je predstavljala 1/3 celotne dolžine konice, kar pomeni optimalno nasaditev osti projektila ali orodja v kopjišče (Brodar, Brodar 1983). Podlaga za takšno določitev baze so:

– 1. Vrezi na robovih ter na sprednji in hrbtni strani terminalnega dela konic, ki jih je praviloma najti samo na dveh tretjinah razdalje od apeksa, medtem ko jih na bazi ni (*sl. 2.1*).

– 2. Bazalni odlomki, ki so praviloma brez vrezov (*sl. 3.4*).

– 3. Terminalni odlomki z vrezi po njihovi celotni dolžini (*sl. 2.1:* 47; *10.7:* 66).

– 4. Predvsem prelomljena konica, sestavljena iz bazalnega in terminalnega odlomka (*sl. 3.4:* 86+125).

Konica št. 86+125 se je na mestu, kjer je štrlela iz toporišča, lahko prelomila samo pri naletu na trdo oviro. Prelom, kot posledica upogiba v sedimentu, ne pride v poštev, zaradi značilne poškodbe (odloma) apeksa, ki nastane pri naletu kopja v trdo oviro (glej Horusitzky 2008). Poleg tega sta bila dela najdena daleč narazen (Brodar, Brodar 1983). V opredelitvi baze so med analitiki precejšna razhajanja (*sl. 2.2*). Nekatere opredelitve se nama zdijo z vidika uporabnosti konic kot osti kopij, sulic ali morda puščic nesmiselne (*sl. 2.3*).

Konice P. z. se na podlagi oblike stranskega profila delijo na ploščate in vretenaste (Horusitzky 2004; 2006; Turk 2005) (*sl. 3.1*). Analitski ločevalni kriterij je debelina konice na prehodu baze v terminalni del (*sl. 12.5*). Glede na velikost sva vse konice razdelila v tri velikostne razrede (*tab. 1*). Percentila 10 in 90, ki zajemata 80 % vseh dolžin, imata pri majhnih konicah razmik 43–65 mm, pri srednjih 69–92 mm in pri velikih 97–150 mm.

Statistična analiza stratificiranega vzorca orinjasjenskih konic P. z. je razkrila nekatere prej manj znane značilnosti vzorca, povezane s tipologijo konic, razvojnimi težnjami in tehnologijo. Na metodološko ustreznejši način je potrdila že znano o merah konic (*sl. 4.1*) in dodatno utemeljila obstoj tipa *konice Potočka zijalka* po rahlo spremenjenem predlogu M. Brodarja (Brodar, Brodar 1983; M. Brodar 2009).

Primerjava najinih izsledkov z izsledki drugih avtorjev, temelječih na drugačnih analitskih pristopih, je pokazala, da je v zvezi s konicami P. z. več vprašanj kot dobro utemeljenih odgovorov. Na enaka vprašanja lahko dobimo različne odgovore, odvisno od tega, kako jih rešujemo. V prispevku sva se vprašanja izdelave, rabe in vzdrževanja konic lotila na način, ki doslej še ni bil uporabljen, in ugotovila naslednje:

Vretenaste konice (*sl. 3.1*), ki so najdebelejše približno na eni tretjini dolžine, utemeljeno predstavljajo poseben tip konice, za katerega je M. Brodar predlagal naziv *konica Potočka zijalka*.

Različne velikosti konic, ki zvezno naraščajo (*sl. 5.1*), so lahko nastale zaradi popravkov poškodovanih primerkov. Konice so tako postale vse krajše in manj uporabne, vsaj kar zadeva lov na veliko divjad. Pogosta prisotnost ostankov velike divjadi na orinjasjenskih najdiščih in posamezni primerki konic, dolgih 200–250 mm, kažejo, da je bilo lahko takšnih konic v uporabi precej več, kot se jih je ohranilo. Vzrok za pomanjkljivo arhe-

1 Vse številke konic se nanašajo na številke konic, objavljenih v monografiji S. in M. Brodarja (1983).

ološko evidenco so lahko popravki poškodovanih konic (*sl. 5.2; 10.7; 12.3*) in pa dejstvo, da so bile zelo dolge konice dragocenejše od vseh ostalih in temu primerno čuvane. Iz medvedjih kosti ni bilo mogoče dobiti nastavkov konic, daljših od 230 mm. Za to, kako so izdelovalci prišli do tako dolgih koščenih nastavkov, obstaja praktična rešitev, ki še ni eksperimentalno popolnoma preverjena. Gre za izvirno tehniko s pomočjo luknjanja in sredinskega vzdolžnega gozdenja namesto predlaganega cepljenja s konca, kot predlagajo Tejero, Christensen in Bodu (2012). Izdelava takšnih nastavkov konic je pomenila velik izziv, posebno če so bile konice izdelane iz kosti, ki se težje vzdolžno cepijo kot rogovje. Nekatere debele srednje velike konice so lahko nastale iz prvotnih zelo dolgih konic, ki so se odlomile apikalno ter na stiku terminalnega dela in baze (*sl. 10.7:* 51). Bazo so kot neuporabno zavrgli (*sl. 3.4*), terminalnemu delu pa so naredili novo bazo, ga ošilili in dobili srednje veliko konico (*sl. 5.2:* 76; *12.3:* 30). Za izdelavo in popravilo konic na kraju samem ni prepričljivih dokazov. To zahteva odgovor na vprašanje, zakaj so ljudje v P. z. pustili različno poškodovane konice skupaj z bolj ali manj celimi konicami. Utemeljen odgovor bo težko najti.

Domneva, da so se konice iz kosti in rogovja ob kamnitih konicah nasajene uporabljale kot lovsko orožje, je splošno sprejeta. Primerno dolge koščene konice so lahko prodrle do notranjih organov in plen v hipu ubile ali ohromile. S kamnitimi konicami to ni bilo mogoče. Smrtno ranjena žival je lahko zbežala, preden je poginila, in treba jo je bilo izslediti. Zato so koščene konice pomenile napredek v lovskem orožju. So pa morale biti konice v ta namen čim daljše. Upoštevati je treba tudi druge prednosti in slabosti prvih in drugih konic. Kamnite konice se je dalo hitreje izdelati, vendar so se tudi hitreje poškodovale do te mere, da se jih ni dalo več popraviti. Bilo jih je tudi težje solidno nasaditi. Samo nasajanje je bilo zahtevnejše kot pri nekaterih koščenih konicah, ki se jih je dalo enostavno potisniti v stržen bezgove palice. Ker je izdelava koščenih konic zahtevala, v primerjavi s kamnitimi, bistveno več truda in časa, je bilo smiselno poškodovane koščene konice popravljati, zlasti ker sta to dopuščali njihova velikost in oblika. Popravke nakazuje, poleg največje debeline konice nad njeno aktualno bazo (*sl. 10.6*), predvsem neskladje med maso in velikostjo številnih konic (*sl. 10.5*).

S. in M. Brodar (1983) ter drugotni avtorji (npr. Verpoorte 2012) so ugotavljali razlike v ohranjenosti konic iz obeh delov jame in jih povezovali z različno rabo prostora in različnimi dejavnostmi. Kljub številnim najdenim odlomkom konic (Brodar, Brodar 1983; Odar 2014) teh, razen v enem primeru (št. 86 in 125) (*sl. 3.4*), ni bilo mogoče sestaviti. Značilne, prej nezaznane razlike med lokacijo spredaj in zadaj so tudi v zastopanosti konic glede na njihovo velikost, natančneje dolžino terminalnega dela. V temnem ozadju jame so dokaj enakomerno zastopane vse velikosti konic ne glede na tip, pri čemer je največ srednje velikih, medtem ko so pri vhodu tri velikosti konic izrazito neenakomerno zastopane. Največ je velikih konic, polovico manj je srednje velikih in samo za vzorec majhnih (*sl. 7.1; tab. 1*). Stanje v ozadju jame bi lahko razložila z namenskim shranjevanjem še uporabnih konic in terminalnih odlomkov, namenjenih predelavi v srednje velike konice. Nekaj razlik merske narave sva ugotovila med lokacijama tudi pri vretenastih konicah in predvsem pri ploščatih. Njihov pomen ni znan.

Analiza stratigrafske lege konic je dala pričakovane rezultate v smislu tehnoloških izboljšav samo v omejenem obsegu. Nad njo sta obupala že S. in M. Brodar (1983). Vzrok je lahko slaba časovna ločljivost med konicami iz posameznih geoloških plasti, kar še posebno velja za konice iz ozadja jame. Resno motnjo lahko pomeni tudi skromna zastopanost konic v posameznih stratumih vzorca, ki je daleč pod zahtevanim minimumom enot. Za boljše rezultate bi potrebovali več konic v različnih geoloških plasteh ali paleolitskih horizontih, ki bi bili časovno dobro ločeni. Najina analiza je pokazala, da bi bilo pri večjem vzorcu mogoče dobiti razvojno smiselne rezultate. Razvoj pomenijo tehnične izboljšave, ki so na koncu privedle do vsestransko optimalne paličaste oblike konice, kakršna je št. 92 (Brodar, Brodar 1983; t. 10: 92). Do nje so v mlajšem paleolitiku verjetno prišli na podlagi naključne oblike konice, kakršna je npr. št. 105, ki se je v vseh pogledih obnesla bolje od takratnih splošno rabljenih konic. Seveda je trajalo, da je nova oblika izpodrinila staro.

Pogoste, komaj vidne zareze na robovih konic in redki urezi na licih veljajo za nekakšno posebnost konic P. z. (Brodar, Brodar 1983), čeprav oboji izjemoma nastopajo tudi na drugih mlajšepaleolitskih najdiščih s konicami. Ima jih dobra tretjina konic, kar je resnično veliko v primerjavi z drugimi najdišči. Zareze imajo tako vretenaste kot ploščate konice vseh velikosti, pri čemer jih je na majhnih konicah le za vzorec (*sl. 9.2*). Največ jih je na vretenastih konicah, ki jih enačimo s tipom *konice Potočka zijalka*. Značilne so predvsem za najbolj trdne in trpežne konice, kot je razvidno na ploščatih konicah (*sl. 9.4b,c*). Zato se med različnimi razlagami, ki se tičejo vloge zarez, nagibava k mnenju, da je lovec z njimi simbolno zaznamoval tiste konice, ki so se pri lovu izkazale kot najbolj zanesljive (najmanj lomljive), ne glede na tip konice. Morda ni naključje, da jih na celih, še neuporabljenih ali še nezadostno preizkušenih konicah ni, razen na konici št. 65. Urezi na licih konic so imeli poleg večkrat poudarjene okrasne vloge lahko tudi simbolni pomen. To kažejo urezi na ploskvi medularnega kanala, ki so brez vsake praktične vrednosti, kar se tiče izdelave konic (glej *sl. 2.1*). Redke posebnosti, povezane z zarezami in urezi, so vedno na levem robu in na medularni strani kostne lupine. Leva je srčna stran in medularna stran, ki je le redko umetno popolnoma spremenjena, je življenjsko pomembnejša, kot zunanja stran kostne lupine. Izsledki statistične analize kažejo, da so zareze pomemben, trenutno slabo proučen element za razumevanje vzorca koščenih konic P. z.

Poškodbe konic P. z. nam lahko povedo, kako so se konice uporabljale. Ker nama je v danem primeru uspelo izključiti možnost nastanka posedimentnih poškodb, sva lahko na podlagi analize poškodb naredila nekaj novih sklepov o rabi konic v jami in njeni soseščini. Velike konice so bile izpostavljene večjim obremenitvam kot srednje velike in majhne. Zaradi večjega vzvoda so se pri izhodu iz toporišča lomile predvsem velike konice. Nastali so bazalni in terminalni odlomki (*sl. 3.4* in *3.5*). Če je bilo kopjišče trdno, so se ploščate konice lomile bolj kot vretenaste, pri katerih se je bolj kot konica lomilo kopjišče. Ponavljajoči se vzorec preloma na določenem mestu na konici si težko razložimo s posedimentnim dogajanjem in z eno samo sestavljenko vseh odlomkov. Dodatna težava je porazdelitev različnih delov konic po plasteh v dveh predelih jame (*sl. 11.2*). Zato se je poskušalo bazalne in terminalne odlomke razložiti tudi v povezavi z različnimi dejavnostmi na različnih lokacijah in popravili osti kopij ali sulic ter predvsem hrambo poškodovanih konic, ki se jih je dalo še popraviti (Brodar, Brodar 1983; Verpoorte 2012).

Velike in majhne konice so se uporabljale enako. Po eni od možnosti kot izstrelki (kopja, puščice), kar pride v poštev predvsem pri vretenastih konicah. Nekatere izmed srednje velikih so bile dimenzionirane tako, da so se dale enostavno in učinkovito nasaditi v stržen bezgove palice, ki je služila kot izjemno trpežno kopjišče lahkih kopij in sulic ali kot vmesnik puščic (Odar 2011), beri majhnih konic. Vse posebej označene konice v *prilogi 2*, ki so ožje in tanjše od 12 mm, se je dalo brez težav nasaditi v stržen bezgove palice. Domnevna uporaba bezga je omogočala tudi enostavno in hitro zamenjavo poškodovane konice z rezervno. Velike ploščate konice so se lahko uporabljale tudi kot sulične osti. Poškodbe, ki so nastale pri lovski rabi konic, so izdelovalcem pomagale odpraviti njihove tehnične pomanjkljivosti in izdelati tehnično izpopolnjen tip *konice Potočka zijalka*.

Konice se splošno sprejeto delijo na konice z razcepljeno in masivno bazo. Slednjim pripadajo vse konice P. z., razen ene. Oblika lica baze je bolj ali manj enaka pri konicah z razcepljeno in masivno bazo. Masivna baza je zmanjšala občutljivost baze za obremenitev in v določenih primerih omogočila enostavno in trdno nasaditev v stržen bezgove palice. Konica je bila ojačana na izhodu iz toporišča, na način, ki je najmanj prizadel prebojnost njenega aktivnega dela. To je bilo doseženo z odebelitvijo tega mesta, ki bolj kot širitev povečuje trdnost konice. Tako so se poleg prvotnih ploščatih profilov širokih konic pojavili vretenasti profili ozkih konic. Razcep baze, ki je pomenil šibko točko, je bil postopno opuščen. Konice z razcepljeno in masivno bazo se razlikujejo samo v načinu nasaditve in v tem, kako so bile ojačane na izhodu iz toporišča: z razširitvijo ali z odebelitvijo.

Statistična analiza vzorca konic P. z. je nazorno pokazala, da je na že večkrat postavljena vprašanja možnih več bolj ali manj utemeljenih odgovorov. Ponujene enoznačne rešitve ključnih vprašanj, brez poglobljene vsestranske analize gradiva in iz tega izhajajoče sinteze, zavračava kot preuranjene (glej Odar 2011 in lokostrelstvo). Zavračava tudi preveč zapletene statistične analize, ki ne dajo enostavnih, preglednih in smiselnih rezultatov, povezanih z nasaditvijo konic (glej Doyon 2017; 2019 in morfotipe, določene na podlagi oblike masivne baze konic, kjer posamezne morfotipe nedopustno predstavljajo tako ploščate kot vretenaste konice P. z., ki so zahtevale različen način nasaditve – *pril. 3*). Neprimerne so domneve, ki se jih ne da eksperimentalno ali analitsko preveriti (glej Odar 2015 in svetišče paleolitskih lovcev).

Izsledki tu predstavljene analize in njihova razlaga so odvisni predvsem od slučajno izbranih in arbitrarno opredeljenih faktorjev, ki predstavljajo kakovostne oznake konic, kot so velikost, tip, stopnja preoblikovanja kostne lupine oziroma nastavka, vrsta poškodbe ipd. (glej *pril. 2*). To pušča odprte možnosti za nadaljnje raziskave na podlagi drugače opredeljenih faktorjev. V prispevku tudi nisva izčrpala vsega, kar ponujajo statistični programi. Zato se bo dalo še marsikaj postoriti. Prikazano v tem prispevku bi se splačalo ponoviti na standardiziranih vzorcih konic (glej Turk 2002; 2005; M. Brodar 2003). Dobrodošla bi bila tudi metoda večdimenzionalnega skaliranja (glej Turk 2014). Dobro poznavanje lastnosti vzorca konic P. z., upoštevanje znanstvenih standardov in etike, ki narekuje pregledno objavo vseh z raziskavo povezanih podatkov, sta temeljna pogoja za zaupanje v točnost arheološke razlage, ne pa tudi za pravilnost razlage.

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App. 1: Basic measures and descriptive statistics for the massive-based points from La Ferrassie (F.) including complete examples (Doyon 2017, Annexe 2) and for the complete points from Potočka zijalka (P. z.).
Pril. 1: Osnovne mere in opisne statistike konic z masivno bazo z najdišča La Ferrassie (F.), vključno s celimi (Doyon 2017, Annexe 2) in celih konic iz Potočke zijalke (P. z.).

	F. Preserved length (mm)	F. Width (mm)	F. Thickness (mm)	F. Complete length (mm)	F. Width (mm)	F. Thickness (mm)	P. z. Complete length (mm)	P. z. Width (mm)	P. z. Thickness (mm)
.	98.5	9.7	6.5	98.5	9.7	6.5	102	15.0	9.0
.	100.9	12.1	8	122.4	9.1	7.7	109	15.5	8.5
.	92.5	11.9	8.1	106.3	23.8	9.7	174	22.0	7.0
.	122.4	9.1	7.7	68.5	9.3	5.2	135	14.5	9.0
.	89.3	7.3	4.1	94.4	9	6.7	99	13.5	9.0
.	36.8	6.3	2.9	98.2	9.3	4.8	80	8.7	4.0
.	106.3	23.8	9.7	118.1	14.8	7.2	112	14.5	7.0
.	139.5	25.7	6.5	153.1	9.8	4.6	113	17.8	9.9
.	145.5	24.7	9.2	106.7	14.4	6.6	86	10.0	6.0
.	71.5	8.1	7.9	132.7	15.7	7.9			
.	63.6	8.4	5.4	130.7	20.9	7.4			
.	68.5	9.3	5.2	95	15.2	7.7			
.	94.4	9	6.7	64.6	10.3	5.6			
.	60.6	10.3	6.3	147.1	17.2	8.9			
.	116.8	20.7	10	95.1	9.7	6.6			
.	147.9	16.5	8.3	146.5	15.9	7.9			
.	98.2	9.3	4.8	121.3	10.3	7.6			
.	91.5	16	7.3	182.1	15.9	6.3			
.	72.4	6.5	5.7	163.7	19.3	6.4			
.	137.2	18.3	9	178.4	17	10.5			
.	178.6	32.6	8.4	169	15.6	7.4			
.	122	26	10.7						
.	145.4	25	7.9						
.	148.3	22.9	10.3						
.	89.4	15.7	7.7						
.	77.8	7.4	4.5						
.	70.6	10.2	6.8						
.	67.4	7.4	5						
.	49.6	10.1	3.8						
.	81.7	9.2	5.2						
.	118.5	9	4.4						
.	82.3	7.1	5.7						
.	115.1	14.6	8.4						
.	117.3	13.8	6.8						
.	125.1	14.1	8.4						
.	118.1	14.8	7.2						
.	62.1	10.6	6.6						

	F. Preserved length (mm)	F. Width (mm)	F. Thickness (mm)	F. Complete length (mm)	F. Width (mm)	F. Thickness (mm)	P. z. Complete length (mm)	P. z. Width (mm)	P. z. Thickness (mm)
.	153.1	9.8	4.6						
.	199	22.5	9.3						
.	106.7	14.4	6.6						
.	93.1	19.3	7.4						
.	132.7	15.7	7.9						
.	112.3	18.3	6.1						
.	136	23	10.8						
.	147.1	22.3	11.4						
.	132	21.4	7.2						
.	92.3	15.7	5.6						
.	180.2	25.8	9.8						
.	84.1	15.8	7.4						
.	90.6	17.1	9.3						
.	193.6	23.5	8.5						
.	123.9	20.6	8.7						
.	153.4	29.8	11.3						
.	129.4	27.1	7.9						
.	120.2	17	8.9						
.	106.9	20.3	9.3						
.	130.7	20.9	7.4						
.	129.2	25.9	10						
.	141.4	21.5	11.4						
.	157.7	26.6	10.7						
.	160.9	21.6	8.9						
.	95	15.2	7.7						
.	88.7	19.9	9						
.	92.2	18.9	7.8						
.	64.6	10.3	5.6						
.	71.4	21.4	10						
.	75.4	18.3	9						
.	130.1	25.3	9.2						
.	138	18.7	7.8						
.	124.5	23.3	8.9						
.	108.4	11.6	8.1						
.	86.3	9.7	7.7						
.	147.1	17.2	8.9						
.	95.1	9.7	6.6						
.	146.5	15.9	7.9						
.	83.9	11.3	9.3						
.	121.3	10.3	7.6						
.	182.1	15.9	6.3						

	F. Preserved length (mm)	F. Width (mm)	F. Thickness (mm)	F. Complete length (mm)	F. Width (mm)	F. Thickness (mm)	P. z. Complete length (mm)	P. z. Width (mm)	P. z. Thickness (mm)
.	163.7	19.3	6.4						
.	178.4	17	10.5						
.	111.3	15.9	6.5						
.	169	15.6	7.4						
.	103.2	18.5	11.3						
.	175.8	23.1	9						
Statistics									
MEAN	115.3	16.6	7.8	123.4	13.9	7.1	112.1	14.6	7.7
MEDIAN	116.0	16.0	7.9	121.3	14.8	7.2	109.0	14.5	8.5
SD	35.8	6.3	1.9	34.0	4.4	1.5	28.1	3.9	1.9
VALID_N	84	84	84	21	21	21	9	9	9
MIN	36.8	6.3	2.9	64.6	9.0	4.6	80.0	8.7	4.0
MAX	199.0	32.6	11.4	182.1	23.8	10.5	174.0	22.0	9.9
_25^{th}%	89.4	10.3	6.5	98.2	9.7	6.4	99.0	13.5	7.0
_75^{th}%	140.5	21.5	9.0	147.1	15.9	7.7	113.0	15.5	9.0
.									
SW-W test (p)	0.087	0.054	0.263	0.455	0.072	0	0.072	0.274	0.014

App. 2: Metric and descriptive characteristics of the points from the P. z. sample and their statistics. Given in bold are: – **1**. The preserved length of large distal and basal fragments and their reconstructed length (Columns 1, 4 and 5). – **2**. Reconstructions over 20% deemed less reliable (Column 3). – **3**. Maximum width and thickness under 11.5 mm that enable hafting into a soft pith of an elder stick (Columns 6 and 7). The measures of complete points are shaded. (The points Nos. 1, 23, 83, 93, 98, 107, 110, 118, 119 and 131 are not included, either because they could not be reconstructed or were not available for measurement).

	1	2	3	4	5	6	7	8	9
Inv. No.	**Preserved length (mm)**	**Reconstructed total length (mm)**	**Reconstruction (%)**	**Reconstructed distal length (mm)**	**Reconstructed basal length (mm)**	**Width (mm)**	**Thickness (mm)**	**Mass (g)**	**Section (mm^2)**
2	154	163	6	109	54	18.5	8.0	19.2	148
3	147	189	**22**	126	63	20.0	11.0	33.3	220
4	142	160	11	107	53	18.0	9.0	23.5	162
5	135	140	4	93	47	16.4	10.5	21.6	172
6	115	124	7	83	41	17.5	11.0	19.0	193
7	114	140	19	93	47	14.0	9.0	13.7	126
8	**110**	187	**41**	**125**	62	17.8	9.0	16.5	160
9	**108**	165	**35**	**110**	55	19.0	8.1	16.9	154
10	102	102	0	68	34	15.0	9.0	12.1	135
11	98	110	11	73	37	**11.0**	**8.2**	9.6	90
12	97	120	19	80	40	20.0	8.5	18.7	170
13	**97**	150	**35**	**100**	50	14.5	8.6	9.0	125
14	93	95	2	63	32	14.0	7.0	8.5	98
15	91	97	6	65	32	**11.0**	**6.0**	5.8	66
16	**88**	135	**35**	**90**	45	15.2	5.1	6.4	78
17	87	150	**42**	100	50	22.0	6.0	12.3	132
18	87	122	**29**	81	41	13.0	8.0	9.1	104
19	85	90	6	60	30	12.4	6.0	5.6	74
20	79	95	17	63	32	**9.0**	**6.0**	4.7	54
21	78	-	-	-	-	16.0	8.5	12.8	136
22	71	80	11	53	27	**10.7**	**6.0**	4.6	64
24	56	130	**57**	87	43	**11.3**	**6.3**	4.6	71
25	53	65	18	43	22	**10.0**	**4.6**	2.4	46
28	137	167	18	111	56	18.0	8.0	18.6	144
29	101	115	12	77	38	15.7	7.0	10.9	110
30	122	132	8	88	44	16.0	11.0	19.0	176
31	180	188	4	125	63	19.0	8.6	25.7	163
32	123	145	15	97	48	16.5	8.0	17.8	132
33	71	105	**32**	70	35	**11.0**	**6.2**	5.2	68
34	95	130	**27**	87	43	17.0	8.5	14.1	145
35	124	144	14	96	48	12.5	9.0	12.9	113
36	65	70	7	47	23	**8.0**	**3.0**	1.4	24
37	174	184	5	123	61	19.5	10.0	31.7	195
38	140	162	14	108	54	14.0	10.0	18.2	140
39	85	92	8	61	31	14.0	6.0	6.2	84
40	70	80	13	53	27	**8.0**	**6.0**	3.2	48
41	93	97	4	65	32	**9.5**	**8.5**	6.4	81
42	180	190	5	127	63	16.5	8.5	23.2	140
43	74	84	12	56	28	**8.5**	**3.6**	2.5	31
44	105	130	19	87	43	16.5	9.0	16.8	149
45	112	117	4	78	39	13.5	8.0	10.6	108
46	73	88	17	59	29	**11.2**	**4.9**	3.4	55

Pril. 2: Metrični in opisni znaki konic vzorca P. z. ter njihove statistike. Krepko so izpisane: –**1**. Največje dolžine velikih terminalnih in bazalnih odlomkov (stolpci 1, 4 in 5). – **2**. Rekonstrukcije, večje od 20 %, ki veljajo za manj zanesljive (stolpec 3). – **3**. Največje širine in debeline, manjše od 11,5 mm, ki omogočajo nasaditev v votlo bezgovo palico (stolpca 6 in 7). Mere celih konic so v rastru. (V tabeli manjkajo konice št. 1, 23, 83, 93, 98, 107, 110, 118, 119 in 131, ker se jih, ali ni dalo rekonstruirati ali nama niso bile dostopne).

	10	11	12	13	14	15	16	17	18	19	20
Inv. No.	**Size**	**Side contour / Type**	**Location**	**Layer Brodar**	**Layer Var. 0**	**Layer Var. 1**	**Layer Var. 2**	**Cuts / Incisions**	**Transform. bone cortex**	**Breakage**	**Edges of breakage**
2	large	flat	back	-	-	-	-	no	insignificant	apical-distal	rounded
3	large	spindle-shaped	back	-	-	-	-	no	-	apical-distal	rounded
4	large	flat	back	-	-	-	-	yes	substantial	apical-distal	rounded
5	medium	spindle-shaped	back	-	-	-	-	no	insignificant	apical-distal	-
6	medium	spindle-shaped	back	-	-	-	-	yes	substantial	apical-distal	sharp
7	medium	spindle-shaped	back	-	-	-	-	no	insignificant	apical-distal	sharp
8	large	flat	back	-	-	-	-	yes	-	basal-distal	rounded
9	large	spindle-shaped	back	-	-	-	-	no	-	basal-distal	sharp
10	medium	spindle-shaped	back	-	-	-	-	no	-	-	-
11	medium	spindle-shaped	back	-	-	-	-	no	-	apical-distal	sharp
12	medium	flat	back	-	-	-	-	yes	insignificant	apical-distal	sharp
13	large	-	back	-	-	-	-	yes	-	-	-
14	small	flat	back	-	-	-	-	no	insignificant	-	-
15	small	flat	back	-	-	-	-	no	insignificant	apical-distal	rounded
16	medium	flat	back	-	-	-	-	yes	-	basal-distal	rounded
17	large	flat	back	-	-	-	-	no	insignificant	basal-distal	sharp
18	medium	spindle-shaped	back	-	-	-	-	no	substantial	apical-distal	sharp
19	small	flat	back	-	-	-	-	no	insignificant	apical-distal	rounded
20	small	flat	back	-	-	-	-	no	substantial	apical-distal	rounded
V	-	-	back	-	-	-	-	yes	-	-	-
22	small	spindle-shaped	back	-	-	-	-	yes	substantial	apical-distal	rounded
24	medium	-	back	-	-	-	-	no	-	-	-
25	small	flat	back	-	-	-	-	yes	insignificant	apical-distal	rounded
28	large	flat	back	5 lower	Lower back	Lower	Middle	no	substantial	apical-distal	sharp
29	medium	flat	back	5 lower	Lower back	Lower	Middle	yes	substantial	apical-distal	rounded
30	medium	spindle-shaped	back	5 upper	Lower back	Lower	Middle	yes	substantial	apical-distal	rounded
31	large	spindle-shaped	back	5 upper	Lower back	Lower	Middle	no	-	apical-distal	rounded
32	large	flat	back	4 middle	Upper back	Upper	Upper	no	insignificant	apical-distal	rounded
33	medium	flat	back	5 lower	Lower back	Lower	Middle	no	insignificant	apical-distal	sharp
34	medium	flat	back	4 lower	Upper back	Upper	Upper	no	-	apical-distal	rounded
35	large	spindle-shaped	back	4 upper	Upper back	Upper	Upper	yes	substantial	apical-distal	rounded
36	small	flat	back	4 upper	Upper back	Upper	Upper	no	insignificant	apical-distal	rounded
37	large	flat	back	4 middle	Upper back	Upper	Upper	yes	-	apical-distal	rounded
38	large	spindle-shaped	back	4 lower	Upper back	Upper	Upper	no	substantial	apical-distal	rounded
39	small	flat	back	4 lower	Upper back	Upper	Upper	no	insignificant	-	-
40	small	spindle-shaped	back	5 middle	Lower back	Lower	Upper	yes	substantial	apical-distal	sharp
41	small	spindle-shaped	back	4 lower	Upper back	Upper	Upper	no	substantial	apical-distal	rounded
42	large	flat	back	4 middle	Upper back	Upper	Upper	no	substantial	apical-distal	rounded
43	small	flat	back	4 lower	Upper back	Upper	Upper	no	insignificant	apical-distal	sharp
44	medium	flat	back	4 lower	Upper back	Upper	Upper	yes	substantial	apical-distal	sharp
45	medium	flat	back	5 upper	Lower back	Lower	Middle	no	substantial	apical-distal	rounded
46	small	flat	back	4	Upper back	Upper	Upper	no	insignificant	apical-distal	sharp

	1	2	3	4	5	6	7	8	9
Inv. No.	**Preserved length (mm)**	**Reconstructed total length (mm)**	**Reconstruction (%)**	**Reconstructed distal length (mm)**	**Reconstructed basal length (mm)**	**Width (mm)**	**Thickness (mm)**	**Mass (g)**	**Section (mm^2)**
47	**126**	210	**40**	**140**	70	17.0	9.0	18.2	153
48	134	161	17	107	54	17.5	6.0	15.9	105
49	182	-	-	-	-	21.5	11.0	46.0	237
50	109	109	0	73	36	15.5	8.5	13.7	132
51	107	115	7	77	38	16.0	10.5	17.8	168
52	92	98	6	65	33	**9.8**	**6.0**	4.8	59
53	174	174	0	116	58	22.0	7.0	24.2	154
54	**91**	160	**43**	**107**	53	17.2	8.1	8.1	139
55	104	154	**32**	103	51	13.3	9.0	12.2	120
56	127	146	13	97	49	18.0	6.0	13.8	108
57	59	75	**21**	50	25	**8.2**	**4.0**	2.2	33
58	66	69	4	46	23	**6.5**	**4.0**	1.7	26
59	46	65	**29**	43	22	**7.3**	**4.0**	4.0	29
60	135	135	0	90	45	14.5	9.0	16.0	131
61	121	123	2	82	41	13.0	6.5	10.5	85
62	101	104	3	69	35	14.0	7.5	9.0	105
63	118	180	**34**	120	60	16.0	9.2	16.3	147
64	156	166	6	111	55	17.0	9.0	22.1	153
65	99	99	0	66	33	13.5	9.0	4.4	122
66	**129**	210	**39**	**140**	70	15.6	6.8	13.3	106
67	73	90	19	60	30	**10.6**	**4.6**	3.2	49
68	124	138	10	92	46	13.5	9.0	13.8	122
69	62	80	**23**	53	27	**9.0**	**4.0**	2.6	36
70	121	132	8	88	44	12.0	7.0	10.1	84
71	86	89	3	59	30	13.0	7.0	7.3	91
72	96	98	2	65	33	**9.0**	**5.5**	4.1	50
73	83	125	**34**	83	42	16.0	7.5	10.6	120
74	83	94	12	63	31	10.5	7.0	6.5	74
75	198	230	14	153	77	31.0	13.0	74.6	403
76	124	132	6	88	44	16.5	10.0	17.6	165
77	80	80	0	53	27	**8.7**	**4.0**	2.7	35
78	99	108	8	72	36	13.0	5.0	5.9	65
79	90	97	7	65	32	**11.0**	**6.0**	5.7	66
80	114	117	3	78	39	20.0	10.0	20.7	200
81	101	106	5	71	35	15.0	8.6	11.8	129
82	134	140	4	93	47	20.0	9.0	22.8	180
90	107	126	15	84	42	19.0	8.0	15.9	152
91	**91**	138	**34**	**92**	46	22.0	7.5	15.6	165
92	132	185	**29**	123	62	12.5	10.5	16.4	131
95	**117**	176	**34**	**117**	59	17.5	7.0	12.3	123
96	**95**	144	**34**	**96**	48	17.5	7.2	11.1	126
97	60	105	**43**	70	35	**9.0**	**6.0**	3.3	54
99	93	103	10	69	34	15.0	7.5	8.4	113
100	112	112	0	75	37	14.5	7.0	11.0	102
101	113	113	0	75	38	17.8	9.9	18.5	176
102	38	40	5	27	13	**6.0**	**5.0**	0.8	30
103	114	-	-	-	-	18.0	6.0	18.0	108
104	**84**	150	**44**	**100**	50	20.0	7.7	12.4	154

	10	11	12	13	14	15	16	17	18	19	20
Inv. No.	**Size**	**Side contour / Type**	**Location**	**Layer Brodar**	**Layer Var. 0**	**Layer Var. 1**	**Layer Var. 2**	**Cuts / Incisions**	**Transform. bone cortex**	**Breakage**	**Edges of breakage**
47	large	flat	back	4	Upper back	Upper	Upper	yes	-	basal-distal	rounded
48	large	flat	back	5 middle	Lower back	Lower	Middle	no	insignificant	apical-distal	sharp
49		flat	front	5	Upper back	Upper	Middle	no	substantial	-	-
50	medium	spindle-shaped	back	4 lower	Upper back	Upper	Upper	no	substantial	-	-
51	medium	spindle-shaped	back	4 middle	Upper back	Upper	Upper	yes	substantial	apical-distal	rounded
52	small	spindle-shaped	back	5 upper	Lower back	Lower	Middle	no	insignificant	apical-distal	sharp
53	large	flat	back	5 upper	Lower back	Lower	Middle	no	insignificant	-	-
54	large	-	back	5 upper	Lower back	Lower	Middle	no	-	basal-distal	sharp
55	large	-	back	5 upper	Lower back	Lower	Middle	no	substantial	apical-distal	rounded
56	large	flat	back	5 upper	Lower back	Lower	Middle	no	insignificant	apical-distal	rounded
57	small	flat	back	4	Upper back	Upper	Upper	no	insignificant	apical-distal	sharp
58	small	spindle-shaped	back	5 upper	Lower back	Lower	Middle	no	insignificant	apical-distal	sharp
59	small	flat	back	5 middle	Lower back	Lower	Middle	no	substantial	apical-distal	sharp
60	medium	flat	back	4 lower	Upper back	Upper	Upper	no	insignificant	-	-
61	medium	spindle-shaped	back	4 middle	Upper back	Upper	Upper	no	-	apical-distal	-
62	medium	spindle-shaped	back	5 upper	Lower back	Lower	Middle	no	substantial	apical-distal	rounded
63	large	flat	back	5 middle	Lower back	Lower	Middle	no	substantial	apical-distal	rounded
64	large	spindle-shaped	back	5 upper	Lower back	Lower	Middle	yes	-	apical-distal	rounded
65	medium	spindle-shaped	back	5 upper	Lower back	Lower	Middle	yes	-	-	-
66	large	flat	back	5 middle	Lower back	Lower	Middle	yes	insignificant	basal-distal	rounded
67	small	flat	back	4 lower	Upper back	Upper	Upper	no	insignificant	-	-
68	medium	spindle-shaped	back	4 lower	Upper back	Upper	Upper	yes	substantial	apical-distal	rounded
69	small	flat	back	4 middle	Upper back	Upper	Upper	no	insignificant	apical-distal	sharp
70	medium	flat	back	5 middle	Lower back	Lower	Middle	yes	substantial	apical-distal	rounded
71	small	flat	back	5 upper	Lower back	Lower	Middle	no	-	apical-distal	rounded
72	small	spindle-shaped	back	5 upper	Lower back	Lower	Middle	no	insignificant	apical-distal	rounded
73	medium	flat	back	5 middle	Lower back	Lower	Middle	no	insignificant	apical-distal	sharp
74	small	spindle-shaped	back	4 middle	Upper back	Upper	Upper	yes	substantial	apical-distal	rounded
75	large	flat	back	5 middle	Lower back	Lower	Middle	yes	-	apical-distal	rounded
76	medium	spindle-shaped	back	5 upper	Lower back	Lower	Middle	no	substantial	apical-distal	rounded
77	small	flat	back	5 middle	Lower back	Lower	Middle	no	insignificant	-	
78	medium	flat	back	5 middle	Lower back	Lower	Middle	no	insignificant	apical-distal	rounded
79	small	flat	back	5 middle	Lower back	Lower	Middle	no	insignificant	apical-distal	rounded
80	medium	spindle-shaped	back	5 middle	Lower back	Lower	Middle	yes	substantial	apical-distal	rounded
81	medium	spindle-shaped	back	5 middle	Lower back	Lower	Middle	no	substantial	apical-distal	rounded
82	medium	flat	back	5 lower	Lower back	Lower	Middle	no	-	apical-distal	rounded
90	medium	flat	front	5	Upper front	Upper	Middle	no	insignificant	-	-
91	medium	flat	front	5	Upper front	Upper	Middle	yes	insignificant	-	-
92	large	-	front	5	Upper front	Upper	Middle	yes	substantial	-	-
95	large	flat	front	7	Lower front	Lower	Lower	no	insignificant	basal-distal	-
96	large	flat	front	7	Lower front	Lower	Lower	yes	insignificant	basal-distal	rounded
97	medium	-	front	7	Lower front	Lower	Lower	yes	substantial	-	-
99	medium	flat	front	7	Lower front	Lower	Lower	no	-	-	-
100	medium	flat	front	5	Upper front	Upper	Middle	no	substantial	-	-
101	medium	spindle-shaped	front	5	Upper front	Upper	Middle	no		-	-
102	small	spindle-shaped	front	5	Upper front	Upper	Middle	no	substantial	-	-
103	-	flat	front	5	Upper front	Upper	Middle	no	substantial	-	-
104	large	flat	front	5	Upper front	Upper	Middle	no	insignificant	basal-distal	rounded

	1	2	3	4	5	6	7	8	9
Inv. No.	**Preserved length (mm)**	**Reconstructed total length (mm)**	**Reconstruction (%)**	**Reconstructed distal length (mm)**	**Reconstructed basal length (mm)**	**Width (mm)**	**Thickness (mm)**	**Mass (g)**	**Section (mm^2)**
105	90	100	10	67	33	12.0	8.0	9.0	96
106	**139**	225	**38**	**150**	75	17.0	10.0	20.8	170
108	**84**	225	**63**	150	**75**	18.0	9.5	13.2	171
109	135	150	10	100	50	16.0	9.0	20.3	144
111	109	135	19	90	45	14.0	8.0	10.6	112
112	**61**	180	**66**	120	**60**	18.0	10.0	10.0	180
113	88	165	**47**	110	55	19.0	8.0	15.3	152
114	**66**	208	**68**	139	**69**	17.0	7.5	11.4	128
116	61	70	13	47	23	**10.0**	**7.0**	3.2	70
117	96	108	11	72	36	12.5	5.5	7.1	69
120	125	155	19	103	52	17.0	10.0	21.2	170
121	**57**	171	**67**	114	**57**	21.5	7.0	7.0	151
122	**110**	165	**33**	**110**	55	23.0	12.5	30.5	288
123	73	165	**56**	110	55	15.0	7.5	9.5	113
124	141	145	3	97	48	15.0	11.0	21.7	165
125 +86	**164**	185	11	**123**	**62**	19.0	9.0	19.5	171
126	**49**	149	**67**	99	**50**	15.0	5.0	5.8	75
127	**80**	240	**67**	160	**80**	16.0	9.0	13.8	144
128	**81**	240	**66**	160	**80**	18.0	6.0	6.3	108
129	81	110	**26**	73	37	13.0	7.0	8.1	91
130	161	185	13	123	62	19.0	8.5	27.3	162
132	**46**	129	**64**	86	**43**	**9.5**	**6.0**	2.1	57
133	**75**	225	**67**	150	**75**	16.0	6.0	5.6	96
134	153	168	9	112	56	25.0	11.2	44.3	280
135	**37**	110	**67**	73	**37**	**9.7**	**5.5**	2.3	53
136	124	245	**49**	163	82	17.7	7.7	22.7	136
s.n. (Gross)	86	86	0	57	29	**10.0**	**6.0**	-	60
Statistics									
MEAN	103	136	21	90	45	15.0	7.7	13.3	121
MEDIAN	99	132	13	88	44	15.2	8.0	12.0	122
SD	33	44	20	29	15	4.2	2.0	10.2	58
VALID N	117	114	114	114	114	117	117	116	117
MIN	37	40	0	27	13	6.0	3.0	0.8	24
MAX	198	245	68	163	82	31.0	13.0	74.6	403
25^{th}%	81	102	6	68	34	12.0	6.0	6.1	75
75^{th}%	124	165	34	110	55	17.8	9.0	18.1	153
.									
SW-W test (sqrt p)	0.94	0.59	0.00	0.59	0.59	0.13	0.07	0.00	0.01

	10	11	12	13	14	15	16	17	18	19	20
Inv. No.	**Size**	**Side contour / Type**	**Location**	**Layer Brodar**	**Layer Var. 0**	**Layer Var. 1**	**Layer Var. 2**	**Cuts / Incisions**	**Transform. bone cortex**	**Breakage**	**Edges of breakage**
105	medium	spindle-shaped	front	7	Lower front	Lower	Lower	no	substantial	apical-distal	rounded
106	large	flat	front	7	Lower front	Lower	Lower	no	-	basal-distal	rounded
108	large	-	front	7	Lower front	Lower	Lower	yes	-	basal-distal	rounded
109	large	flat	front	7	Lower front	Lower	Lower	yes	insignificant	apical-distal	rounded
111	medium	spindle-shaped	front	7	Lower front	Lower	Lower	no	substantial	apical-distal	sharp
112	large	spindle-shaped	front	7	Lower front	Lower	Lower	yes	-	basal-distal	sharp
113	large	flat	front	7	Lower front	Lower	Lower	yes	insignificant	apical-distal	sharp
114	large	flat	front	7	Lower front	Lower	Lower	no	-	-	-
116	small	spindle-shaped	front	7	Lower front	Lower	Lower	no	-	apical-distal	sharp
117	medium	flat	front	7	Lower front	Lower	Lower	no	insignificant	apical-distal	rounded
120	large	spindle-shaped	front	7	Lower front	Lower	Lower	no	insignificant	apical-distal	rounded
121	large	flat	front	7	Lower front	Lower	Lower	no	-	basal-distal	sharp
122	large	spindle-shaped	front	7	Lower front	Lower	Lower	no	substantial	basal-distal	rounded
123	large	-	front	7	Lower front	Lower	Lower	no	-	-	-
124	large	spindle-shaped	front	7	Lower front	Lower	Lower	yes	substantial	apical-distal	rounded
125 +86	large	flat	front	7	Lower front	Lower	Lower	no	insignificant	basal-distal	-
126	large	flat	front	7	Lower front	Lower	Lower	no	-	basal-distal	sharp
127	large	-	front	7	Lower front	Lower	Lower	no	-	basal-distal	rounded
128	large	flat	front	7	Lower front	Lower	Lower	no		basal-distal	rounded
129	medium	spindle-shaped	front	7	Lower front	Lower	Lower	yes	insignificant	apical-distal	sharp
130	large	flat	front	5	Upper front	Upper	Middle	no	-	apical-distal	-
132	medium	-	front	7	Lower front	Lower	Lower	yes	-	basal-distal	sharp
133	large	flat	front	7	Lower front	Lower	Lower	no	-	basal-distal	-
134	large	flat	front	-	-	-	-	yes	-	apical-distal	sharp
135	medium	-	front	-	-	-	-	yes	-	basal-distal	sharp
136	large	flat	front	-	-	-	-	yes	insignificant	basal-distal	rounded
s.n. Gross	small	-	back	-	-	-	-	no	substantial	-	-

App. 3: Points from P. z. that Doyon (2017, Annexe. 2) analysed in his sample of split- and massive-based points, with added Doyon's serial numbers and comparable data from *App. 1*. The morphotypes in bold are those that Doyon estimated without explaining how. The lengths given in bold signify complete points. Doyon lists eleven, we list three (shaded). The points Nos. 9, 28, 39, 48, 49, 55, 73, 81, 105 and 117 are noted as made of antler, No. 134 of ivory, others of bone. The table also gives three versions of base lengths: by us, by Doyon (2017) and by Horusitzky (2008).

	1	2	3	4	5	6
P. z. Inv. No. (**Doyon's No.**)	**Side contour / Type** **Turk**	**Morphotype** **Doyon**	**Preserved length** **Brodar (mm)**	**Preserved length** **Doyon (mm)**	**Reconstructed distal length** **Turk (mm)**	**Length distal** **Doyon (mm)**
3 (3034)	spindle-shaped	M05	147.0	144.6	126.0	-
7 (3035)	spindle-shaped	M02	114.0	113.7	93.3	-
8 (3036)	flat	**M01**	110.0	109.1	124.7	-
9 (3037)	spindle-shaped	**M07**	108.0	108.0	110.0	-
10 (3038)	spindle-shaped	M02	**102.0**	**100.5**	68.0	55.7
11 (3039)	spindle-shaped	M02	98.0	97.8	73.3	-
12 (3040)	flat	M02	97.0	97.2	80.0	-
14 (3042)	flat	M02	**93.0**	**92.7**	63.3	51.0
15 (3043)	flat	M01	91.0	90.9	64.7	-
17 (3045)	flat	TDB	87.0	87.1	100.0	-
18 (3046)	spindle-shaped	**M07**	87.0	86.2	81.3	-
19 (3047)	flat	M01	85.0	85.5	60.0	-
20 (3048)	flat	M01	79.0	79.0	63.3	-
22 (3050)	spindle-shaped	M01	71.0	71.3	53.3	-
28 (3052)	flat	**M07**	137.0	136.3	111.3	-
29 (3053)	flat	M02	101.0	100.7	76.7	-
32 (3054)	flat	M02	123.0	123.3	96.7	-
33 (3055)	flat	M01	71.0	70.9	70.0	-
34 (3056)	flat	M05	95.0	94.7	86.7	-
35 (3057)	spindle-shaped	M02	124.0	123.8	96.0	-
39 (3059)	flat	M01	**85.0**	**85.3**	61.3	56.0
44 (3060)	flat	M02	105.0	104.8	86.7	-
45 (3061)	flat	M02	**112.0**	**110.9**	78.0	63.6
46 (3062)	flat	M01	73.0	72.8	58.7	-
48 (3064)	flat	M02	134.0	133.6	107.3	-
49 (3065)		M05	182.0	180.0	-	-
50 (3066)	spindle-shaped	M02	**109.0**	**108.6**	72.7	80.0
51 (3067)	spindle-shaped	M05	107.0	107.1	76.7	-
55 (3069)		M02	104.0	104.0	102.7	-
56 (3070)	flat	M04	127.0	126.6	97.3	-
62 (3071)	spindle-shaped	M02	**100.5**	**100.3**	69.3	59.9
63 (3072)	flat	M05	118.0	118.3	120.0	-
65 (3073)	spindle-shaped	M02	**99.0**	**98.1**	66.0	59.6
67 (3075)	flat	M01	73.0	72.4	60.0	-
71 (3076)	flat	M02	**86.0**	**85.2**	59.3	45.6

Pril. 3: Vzorec konic P. z., ki ga je v sklopu vseh konic z razcepljeno in masivno bazo analiziral Doyon (2017, Annexe 2) z dodanimi inventarnimi številkami in primerljivimi podatki iz *pril. 1*. Morfotipi v krepkem tisku so bili po navedbi Doyona ocenjeni (*estimé*). Kako, nama ni znano. Dolžine v krepkem tisku pomenijo cele konice. Doyon jih ima 11, midva samo 3, ki so označene z rastrom. Konice št. 9, 28, 39, 48, 49, 55, 73, 81, 105 in 117 naj bi bile iz rogovja, št. 134 pa iz mamutovine. Vse ostale so koščene. V tabeli so navedene tudi tri različice za dolžino baze, in sicer najina, Doyonova (2017) in Horusitzkyjeva (2008).

	7	8	9	10	11	12	13
P. z. Inv. No. (Doyon's No.)	**Reconstructed basal length Turk (mm)**	**Length proximal Doyon (mm)**	**Reconstructed basal length Horusitzky (mm)**	**Width Brodar (mm)**	**Width Doyon (mm)**	**Thickness Brodar (mm)**	**Thickness Doyon (mm)**
3 (3034)	63.0	53.2	50.0	20.0	19.7	11.0	11.3
7 (3035)	46.7	37.6	35.0	14.0	14.0	9.0	8.8
8 (3036)	62.3	-	44.5	17.8	18.9	9.0	8.8
9 (3037)	55.0	-	47.5	19.0	19.0	8.1	8.3
10 (3038)	34.0	44.8	37.5	15.0	14.2	9.0	8.7
11 (3039)	36.7	34.7	27.5	11.0	11.1	8.2	8.3
12 (3040)	40.0	48.9	50.0	20.0	20.7	8.5	8.5
14 (3042)	31.7	41.8	35.0	14.0	14.2	7.0	6.9
15 (3043)	32.3	31.7	27.5	11.0	11.3	6.0	5.5
17 (3045)	50.0	-	55.0	22.0	22.3	6.0	6.2
18 (3046)	40.7	-	32.5	13.0	12.8	8.0	8.5
19 (3047)	30.0	-	31.0	12.4	12.8	6.0	6.2
20 (3048)	31.7	24.3	22.5	9.0	9.5	6.0	6.0
22 (3050)	26.7	35.5	26.8	10.7	10.8	6.0	5.9
28 (3052)	55.7	-	45.0	18.0	18.3	8.0	7.9
29 (3053)	38.3	41.0	39.3	15.7	16.2	7.0	6.8
32 (3054)	48.3	55.1	41.3	16.5	17.2	8.0	8.3
33 (3055)	35.0	38.3	27.5	11.0	11.0	6.2	6.3
34 (3056)	43.3	61.3	42.5	17.0	16.8	8.5	8.5
35 (3057)	48.0	40.4	31.3	12.5	12.4	9.0	9.4
39 (3059)	30.7	29.3	35.0	14.0	14.3	6.0	5.7
44 (3060)	43.3	47.3	41.3	16.5	17.5	9.0	8.6
45 (3061)	39.0	47.3	33.8	13.5	13.8	8.0	7.8
46 (3062)	29.3	43.5	28.0	11.2	11.5	4.9	5.1
48 (3064)	53.7	47.7	43.8	17.5	17.8	6.0	5.7
49 (3065)	-	68.1	53.8	21.5	21.7	11.0	10.2
50 (3066)	36.3	28.5	38.8	15.5	15.4	8.5	8.8
51 (3067)	38.3	55.1	40.0	16.0	16.2	10.5	10.5
55 (3069)	51.3	48.9	33.3	13.3	13.1	9.0	8.7
56 (3070)	48.7	31.3	45.0	18.0	18.3	6.0	6.1
62 (3071)	34.7	40.5	35.0	14.0	14.0	7.5	7.4
63 (3072)	60.0	66.6	40.0	16.0	16.4	9.2	9.0
65 (3073)	33.0	38.6	33.8	13.5	13.3	9.0	8.9
67 (3075)	30.0	27.9	26.5	10.6	10.6	4.6	4.4
71 (3076)	29.7	39.6	32.5	13.0	12.5	7.0	6.7

	1	2	3	4	5	6
P. z. Inv. No. **(Doyon's No.)**	**Side contour / Type** **Turk**	**Morphotype** **Doyon**	**Preserved length** **Brodar (mm)**	**Preserved length** **Doyon (mm)**	**Reconstructed distal length** **Turk (mm)**	**Length distal** **Doyon (mm)**
73 (3077)	flat	M02	83.0	82.7	83.3	-
74 (3078)	spindle-shaped	**M02**	83.0	83.3	62.7	-
78 (3079)	flat	M01	99.0	98.8	72.0	-
79 (3080)	flat	M01	**90.0**	**89.1**	64.7	55.9
81 (3081)	spindle-shaped	M02	**101.0**	**100.6**	70.7	63.7
90 (3083)	flat	**M02**	107.0	106.6	84.0	-
99 (3084)	flat	M02	93.0	92.8	68.7	-
104 (3085)	flat	**TDB**	84.0	83.6	100.0	-
105 (3086)	spindle-shaped	**M03**	90.0	90.3	66.7	-
111 (3088)	spindle-shaped	M02	109.0	109.6	90.0	-
113 (3090)	flat	M02	88.0	89.0	110.0	-
117 (3091)	flat	M01	**96.0**	**96.0**	72.0	58.3
120 (3092)	spindle-shaped	M05	125.0	125.4	103.3	-
129 (3094)	spindle-shaped	**M07**	81.0	81.4	73.3	-
130 (3095)	flat	M05	161.0	160.0	123.3	-
134 (3097)	flat	M05	153.0	153.5	112.0	-
136 (3098)	flat	**M02**	123.8	123.7	163.3	-
Statistics						
MEAN			103.9	103.6	85.0	59.0
MEDIAN			99.8	99.6	78.0	58.3
SD			23.3	23.1	22.9	8.7
VALID_N			52.0	52.0	51.0	11.0
MIN			71.0	70.9	53.3	45.6
MAX			182.0	180.0	163.3	80.0
_25th%			87.0	86.7	66.7	55.7
_75th%			113.0	112.3	100.0	63.6

	7	8	9	10	11	12	13
P. z. Inv. No. **(Doyon's No.)**	**Reconstructed basal length** **Turk (mm)**	**Length proximal** **Doyon (mm)**	**Reconstructed basal length** **Horusitzky (mm)**	**Width** **Brodar (mm)**	**Width** **Doyon (mm)**	**Thickness** **Brodar (mm)**	**Thickness** **Doyon (mm)**
73 (3077)	41.7	35.5	40.0	16.0	16.2	7.5	8.1
74 (3078)	31.3	-	26.3	10.5	11.3	7.0	7.0
78 (3079)	36.0	40.3	32.5	13.0	13.7	5.0	5.0
79 (3080)	32.3	33.3	27.5	11.0	10.9	6.0	5.7
81 (3081)	35.3	36.9	37.5	15.0	15.4	8.6	9.3
90 (3083)	42.0	-	47.5	19.0	-	8.0	7.8
99 (3084)	34.3	36.4	37.5	15.0	15.5	7.5	7.3
104 (3085)	50.0	-	50.0	20.0	20.1	7.7	7.7
105 (3086)	33.3	-	30.0	12.0	11.8	8.0	8.2
111 (3088)	45.0	50.6	35.0	14.0	14.0	8.0	7.9
113 (3090)	55.0	46.5	47.5	19.0	19.1	8.0	8.3
117 (3091)	36.0	37.8	31.3	12.5	12.5	5.5	5.5
120 (3092)	51.7	56.6	42.5	17.0	17.6	10.0	12.7
129 (3094)	36.7	-	32.5	13.0	12.8	7.0	7.1
130 (3095)	61.7	59.5	47.5	19.0	19.3	8.5	8.2
134 (3097)	56.0	58.7	62.5	25.0	24.7	11.2	11.2
136 (3098)	81.7	-	44.3	17.7	17.9	7.7	8.7
Statistics							
MEAN	42.5	43.5	38.1	15.2	15.3	7.7	7.8
MEDIAN	39.0	40.8	37.5	15.0	14.3	8.0	8.0
SD	11.4	10.8	8.7	3.5	3.5	1.6	1.7
VALID_N	51.0	40	52	52	51	52.0	52.0
MIN	26.7	24.3	22.5	9.0	9.5	4.6	4.4
MAX	81.7	68.1	62.5	25.0	24.7	11.2	12.7
_25th%	33.3	36.0	31.9	12.8	12.5	6.1	6.3
_75th%	50.0	49.8	44.4	17.8	17.9	8.8	8.7