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Is Trauma at Krapina like all Other Neandertal Trauma? A Statistical Comparison of Trauma Patterns in Neandertal Skeletal Remains

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Abstract

All instances of trauma reported or personally observed in any known Neandertal skeletal remain were assembled and classified in several ways: 1) whether or not recovered at Krapina; 2) part of the body injured; 3) side of the body injured; 4) sex; and 5) kind of injury. Pairs of these classifications were tested for independence using ACTUS2, a statistical simulation technique appropriate the comparison of small samples. Among bones recovered at Krapina, trauma was significantly concentrated in head and arms, with weak trends away from hands and feet. Comparing Krapina to the other Neandertal samples, weak trends for more trauma in hands and feet at Krapina remain, with weak trends for trunk trauma in the other Neandertal samples. Not even weak trends distinguished Krapina from other samples with respect to side of body. Samples known to be male showed slightly more trauma in other Neandertal specimens, but specimens of undetermined sex showed more trauma at Krapina. Significant differences in kind of trauma were revealed, with more cranial depression fractures at Krapina and less elsewhere, and with a trend for postcranial fractures to be more common outside Krapina. The Neandertal specimens from anywhere but Krapina represent a time spectrum of tens of thousands of years and a widely dispersed geography. The disparate nature of this metasample mitigates the conclusions.

INTRODUCTION

The study of Neandertal trauma has been a part of paleoanthropology since a strange looking skeleton was pulled out of Feldhofer cave near the Neander Valley and described by scientists in the mid-nineteenth century. In view of its traumas, Mayer *(1)* proposed that that this individual was a Mongolian Cossack from the Russian Army who, upon being wounded during the march across Germany into France in 1814, crawled into the cave and died. Although Neandertal antiquity now extends quite a bit farther back than the Napoleonic Wars, more recent studies still hypothesize close encounters with large mammals as a source of much of the Neandertal trauma *(2)* as well as the perils of crawling into caves *(3)*. The study of trauma is fascinating for many reasons, among them ways of understanding the lives of particular human beings *(3, 4),* and social interactions of an entire group *(5, 6)*. However, beguiling as it might be to study trauma, there are many limitations to how data about trauma can be collected and compared and to the kind of conclusions that may be drawn from its presence or absence in a population. This paper compares the patterns of trauma observed in the Neandertal remains from Krapina with patterns of trauma in the rest of the known Neandertal remains, here termed the »Neandertal trauma Metasample.«

One of the major ways that systematic studies of Neandertal trauma *(2, 8, 9, 10)* seems to differ methodologically from studies of trauma in more modern human groups *(e.g., 11, 12)* is that Neandertals with trauma are viewed as one »Metasample« even though specimens are separated by almost 100k years and thousands of miles whereas modern human samples come from a very specific region and limited time range. The underlying assumption made by lumping all Neandertals into one group is that their environments, resources, technologies, life ways and cultures were uniform. There is little evidence to support this assumption. Therefore, grouping all Neandertal traumas into one large sample may not be so revelatory as other paleopathological studies conducted on single groups of modern humans. Besides temporal and geographical variation, Neandertals also vary in how they came to be preserved *(13)*. Some Neandertals, like Kebara and the Shanidar remains were discovered in a relatively complete state with most skeletal elements of each individual intact but »94% of the known Neandertal individuals in Europe are represented by only a few disarticulated bones« (13:514). In these disarticulated bones, visible indications of trauma may be obscured by taphonomical changes such as postmortem breakage or rodent gnawing. Although trauma may be more readily observed in specimens that are better preserved, comparisons of the best-preserved specimens *(10)* do not necessarily represent a demographic cross-section. The lack of preservation of some age brackets or of one sex in the »well-preserved« sample may distort the results of studies based on them.

Because the Neandertal remains from Krapina sample individuals from one geographical location and a time span of no more than 20kyr *(14),* they are likely to be the result of more uniform environmental conditions than the Neandertal trauma Metasample as a whole. The sample from Krapina is also large enough to attempt hypothesis testing. Its Minimum Number of Individuals (MNI) estimates range from 14 *(15)* to 75–82 *(16)*. The Krapina sample includes elements from almost every bone in the body. Most importantly, it is excellently curated and catalogued *(17, 18)* so that the total number of skeletal elements represented has been published and assessments of trauma are accessible and repeatable. Recent work has demonstrated that the demographic sample found at Krapina is consistent with other Paleolithic populations *(19)*. All these factors suggest that the sample from Krapina is an ideal population on which to examine patterns of trauma.

However, even under these »ideal« conditions, it must be remembered that trauma is a rare event. In the Krapina sample, even at the conservative estimate of bones more 25% complete of 292 skeletal elements *(7),* trauma is observed only in eight of them. This means that only 2.7% of the relatively unbroken part of the Krapina collection shows any trauma at all. Of the entire collection (693 skeletal elements), the percentage shrinks to 1.2% of the collection displaying trauma. Because of this rareness, counts of trauma are small and their statistical utility is somewhat limited.

This paper tests the general hypothesis that the Neandertal trauma Metasample manifests patterns of trauma that are not different from those shown in the sample of Neandertals at Krapina. There are several ways to assess »patterns of trauma.« A pattern can be the frequency with which trauma appears in any particular body part or region, it can be the demographic profile of who is injured within the group, or it can be the frequencies of different types of trauma (i.e. fracture, incision, depression etc.). This paper tests patterns of trauma in regions of the body, side of the body, sex of the injured individual, and type of trauma.

THE TRAUMA SAMPLE

Trauma data for the Krapina sample were taken from the following sources: the author's unpublished data, Mann and Monge 2006 *(3),* Gardner and Smith 2006 *(7),* Kricun *et al.* 1999 *(17),* and Radovčić *et al.* 1988 *(16)*. Trauma data for the Neandertal Metasample was taken primarily from Berger and Trinkaus 1995 *(2)* and their sources *(20–27)* as well as a few other samples that have been observed more recently: a pelvis from Skhul *(28, 29),* the Le Moustier I cranium *(30)* and the St. Cesaire cranium *(31)*.

For each specimen, its site name, references, sex of individual (male, female or unknown), side affected, bone affected and description of trauma was recorded. Each injury was then also coded into one of seven body regions to facilitate comparison to Berger and Trinkaus (2): head (cranium and mandible), trunk (vertebra, sternum and ribs), arms (clavicle, scapula, humerus, radius, and ulna), hands, pelvis (innominate and sacrum), leg (femur, tibia and fibula) and feet. In addition, a short code was used to classify the type of trauma observed: »break« (for fractures), »depress« (for a cranial depression fracture), »scalp« (for a non-depression, non-penetrating injury to the scalp), and »slash« (for a penetrating injury to the cranium or pelvis). Multiple injuries on a single individual were treated as independent and were listed separately as were single injuries that appeared on more than one bone. Age at death for each individual was also recorded when known. However, due to the fragmentary nature of the Krapina sample it was difficult to assess age at death for each bone showing trauma and comparisons between the Krapina trauma sample and the Neandertal trauma Metasample could not be made. Only directly observed trauma was recorded since data on degenerative joint disease (DJD) seemed to be variably recorded in the sample and does not always have a traumatic etiology. An Excel file containing all the trauma information for the Nean-

TABLE 1

Counts of all bones at Krapina distinguished by presence or absence of trauma, and body part.

Region of the Body	# Bones with No Trauma	# of Bones with Trauma
Head	58	5
Trunk	42	0
Arm	22	3
Hands	66	0
Pelvis	1	0
Leg	39	0
Feet	56	0

dertal Metasample and the Krapina samples is available at http://www-Personal.umich.edu/~gfe. Counts were taken of the Neandertal Metasample and the Krapina sample in the following areas: region of body injured, type of injury, sex of individual injured and side of body injured.

ASSESSING PATTERNS OF TRAUMA AT KRAPINA USING ACTUS2

The computer program, ACTUS (Analysis of Contingency Tables Using Simulation) version 2 *(32)* can calculate estimates of realized significance from small data sets. It compares two classifications under the null hypothesis that they are independent. Instances are classified by each of the two classifications and counts arrayed in a contingency table. The results of an ACTUS2 analysis show whether the entire contingency table rejects the null hypothesis and which cells are larger or smaller than predicted. ACTUS2 runs under WINDOWS or DOS and is available to download with explanations and examples from http://www-Personal.umich/~gfe/.

The use of ACTUS2 can be illustrated using the Neandertal skeletal remains from Krapina with at least 25% of the bone present to test the hypothesis that instances of trauma are observed in each of seven body regions in proportion to the number of bones representing that region. To test this hypothesis using ACTUS2 bones are classified in two ways: 1) whether they show trauma and 2) what region of the body they represent. Counts are arranged in a contingency table, as shown in Table 1, where 58 bones from the head showed no trauma and 5 bones from the head showed trauma, etc.

Under the null hypothesis, the expected value of each count can be calculated as its row frequency times its column frequency divided by the total number of bones in the whole sample. Table 2 shows expected values for the counts in Table 1.

The extent to which these expected values differ from the observed counts is measured as the difference: the expected value minus the observed count, as shown for each cell in Table 3.

TABLE 2

Numbers of observations expected under the null hypothesis with row frequencies (RF) and column frequencies (CF).

Region of the Body	# Bones with No Trauma	# of Bones with Trauma	Row Frequencies (RF)
Head	61.3	1.7	63
Trunk	40.8	1.2	42
Arm	24.3	0.7	25
Hands	64.2	1.8	66
Pelvis	1.0	0.0	1
Leg	37.9	1.1	39
Feet	54.5	1.5	56
Column Frequencies (CF)	284	8	292

TABLE 3

Deviations of observed counts Table 1 from expected values shown in Table 2.

Region of the Body	# Bones with No Trauma	# of Bones with Trauma
Head	–3.3	3.3
Trunk	1.2	–1.2
Arm	–2.3	2.3
Hands	1.8	–1.8
Pelvis	0.0	0.0
Leg	1.1	–1.1
Feet	1.5	–1.5

The sum over all the cells in Table 3 of absolute value of these differences, termed SAD (Sum Absolute Differences), is a measure of the extent to which the whole table differs from what would be expected under the null hypothesis. ACTUS2 determines whether this extent is large enough to reject the null hypothesis as inconsistent with the observed counts by simulating a large number of contingency tables with the same rows and columns and the same number of bones, typical of what might be observed if the null hypothesis were true. To simulate a table, for each of the 292 bones it assigns a row with probability proportional to the frequency of bones actually observed in that row and, independently, a column with probability proportional to the frequency of the bones actually observed in that column. It then calculates a value of SAD for that simulated table. In the

TABLE 4

In each cell is the number of simulated tables (scaled out of 1000) whose count for that cell was not less than the observed count for that cell.

Region of the Body	# Bones with No Trauma	# of Bones with Trauma
Head	724	29
Trunk	448	1000
Arm	715	30
Hands	417	1000
Pelvis	617	1000
Leg	437	1000
Feet	431	1000

TABLE 5

In each cell is the number of simulated tables (scaled out of 1000 whose count for that cell did not exceed the observed count for that cell.

Region of the Body	# Bones with No Trauma	# of Bones with Trauma
Head	325	992
Trunk	615	320
Arm	369	995
Hands	635	164
Pelvis	747	973
Leg	623	338
Feet	627	218

analyses to follow, 10000 such tables are simulated. The realized significance of the observed value for SAD is estimated as the proportion of simulated tables with a value of SAD greater or equal to the observed value. An observed value of SAD that is so large that only a small proportion of simulated tables have a value of SAD as least that large supports an argument to reject the null hypothesis.

Turning again to the specific example, SAD is the sum of the absolute values of the 14 numbers in Table 4, which equals 22.36. ACTUS2 simulated 10000 tables under the null hypothesis that instances of trauma were independent of regions of the body. Out of 10000 simulations, the SAD values calculated from simulated tables were equal to or exceeded 22.36 (the SAD value calculated from the observed table) only 17 times. This estimates a realized significance of $p= 0.0017$, which might be rounded to $p=0.002$. Thus, we reject the null hypothesis and conclude that some regions of the body have trauma significantly more often or less often than the relative frequency of the bones recovered from that region. The counts in Table 1 suggest that trauma to the head and arm regions occurs more often, and to all other regions of the body less often, because the only instances of trauma are to the head or arm, and other regions of the body show none.

However are these values large or small enough to be significant? To determine whether any counts are significantly large, ACTUS2 counts the number of simulated tables with a count for each cell that was not less than the observed count for that cell. For uniform format, these counts are scaled to 'out of 1000'; they are shown Table 4. To estimate the realized significance that an observed count is too large to be consistent with the null hypothesis, the number in its corresponding cell is divided by 1000.

These results show that the 5 instances of trauma in the head are significantly many with realized $p = 0.029$, and the 3 instances of trauma in the arms are also significantly many with $p = 0.030$. This confirms what the original table of counts suggests. However, are all zeros reported for the other regions of the body significantly few?

To determine whether any counts are significantly few, ACTUS2 counts the number of simulated tables with a count for each cell that was not more than the observed count for that cell. For uniform format, these counts are scaled to 'out of 1000'; they are shown in Table 5. To estimate the realized significance that an observed count is significantly small to be consistent with the null hypothesis, the number in its corresponding cell is divided by 1000.

None of the zeros from the original trauma counts is shown to be very significantly smaller than expected under the null hypothesis, but there are weak trends toward too few instances of trauma in hands ($p = 0.16$) and feet ($p = 0.22$). These ACTUS2 results are somewhat less obvious from the table of counts alone. Any argument that the lack of observed trauma in trunk, pelvis or leg is inconsistent with the null hypothesis would have no basis in data, and the lack of observed trauma in hands and feet is only very weakly inconsistent with the null hypothesis.

PATTERNS OF TRAUMA IN NEANDERTALS

There are several ways to assess »patterns of trauma.« A pattern can be the frequency with which trauma appears in any particular body part or region, it can be the demographic profile of who is injured within the group, or it can be the frequencies of different types of trauma (i.e. fracture, incision, depression etc.). This paper tests the null hypothesis that Neandertal trauma Metasample does not manifest a pattern of trauma different in regions of the body showing injury, side of the bones injured, sex of the injured individual, and type of trauma than that seen in the Neandertal remains at Krapina. These hypotheses were tested with data using ACTUS2 as described

TABLE 6

Counts of instances of trauma observed in bones from the seven body regions in the Neandertal trauma Metasample and recovered at Krapina with very weak trends in smaller (–) or larger (+) counts indicated.

Region of the Body	Neandertal Trauma Metasample	Trauma at Krapina
Head	9	5 +
Trunk	5	0 –
Arm	4	3 +
Hands	1	0
Pelvis	1	0
Leg	3	0
Feet	1	0

above. In presenting results of ACTUS2 analyses for the remaining questions, only the table of observed counts will be shown, with large counts followed by + for very weak trend ($p < 0.3$), by ++ for weak trend ($p < 0.15$), and by +++ for significant ($p < 0.05$). Similarly small counts will be followed by –, – –, or – – – to indicate the same levels of significance.

Null hypothesis A: Instances of trauma observed among the bones in the Neandertal trauma Metasample occur in the same proportions among the regions of the body as they do in bones recovered at Krapina.

The sum of absolute differences (SAD) values were equal to or exceeded 11.00, the SAD value calculated from the observed table, for 1397 out of 10000 simulated tables, $p = 0.14$. (Please refer to the previous section for a more complete explanation of SAD and its significance.) This fails to reject the null hypothesis that trauma occurs in the seven body regions with the same frequency in the Neandertal trauma Metasample as at Krapina. There are very weak trends in a slight tendency for observations of trauma in bones recovered at Krapina to be less frequent among bones in the trunk region ($p = 0.27$) and more frequent among bones of the head ($p = 0.27$) and arms ($p = 0.25$).

Hypothesis B: Instances of trauma observed among bones in the Neandertal trauma Metasample occur in the same proportions among right, left and center of the body as they do in bones recovered at Krapina.

The SAD values were equal to or exceeded 3.2, the SAD value calculated from the observed table, for 7034 out of 10000 simulated tables, $p = 0.70$. The whole table is consistent with the null hypothesis that trauma occurs among bones from the right, left and center of the body with the same frequency at Krapina as in the Neandertal trauma Metasample. The most inconsistent count is the 3 instances of trauma observed in bones from the center of the body recovered in the Neandertal trauma Metasample, but its realized significance is only $p = 0.37$ so it is beyond being categorized even as a weak trend.

TABLE 7

Counts of instances of trauma observed in bones from right, the left and the center of the body among bones in the Neandertal trauma Metasample and recovered at Krapina with very weak trends in smaller (–) or larger (+) counts indicated.

Side of Body	Neandertal Trauma Metasample	Trauma at Krapina
Right	11	4
Left	8	4
Center	3	0

TABLE 8

Counts of instances of trauma observed in bones of males, females, or sex could not be determined because the specimen is a juvenile or there are insufficient skeletal remains among bones in the Neandertal trauma Metasample and recovered at Krapina with very weak trends in smaller (–) or larger (+) counts indicated.

Sex of Individual	Neandertal Trauma Metasample	Trauma at Krapina
Male	9 +	2
Female	3	3
Undetermined Sex	2	3 +

Hypothesis C: Instances of trauma observed among bones in the Neandertal trauma Metasample occur in the same proportions among sexes as in bones recovered at Krapina.

The SAD values were equal to or exceeded 8.00, the SAD value calculated from the observed table, for 1247 out of 10000 simulated tables, $p = 0.12$. The whole table shows a weak trend to reject the null hypothesis that trauma occurs among the three genders with the same frequency at Krapina as in the Neandertal trauma Metasample.

The trend seems to be evidenced by a slight tendency for observations of trauma in bones recovered at Krapina to be more frequent among individuals whose sex could not be determined ($p = 0.28$) and in the Neandertal trauma Metasample to be more frequent among males ($p = 0.22$).

Hypothesis D: Instances of trauma observed among bones in the Neandertal trauma Metasample occur in the same proportions among the different types of trauma (break or postcranial fracture, cranial depression fracture, non-penetrating scalp wound, and slash or penetrating injury to cranium or pelvis) as in bones recovered at Krapina.

The SAD values were equal to or exceeded 10.67, the SAD value calculated from the observed table, for 344 out of 10000 simulated tables, p = 0.03. The whole table rejects the null hypothesis that trauma occurs among the types of trauma with the same frequency at Krapina as in the Neandertal trauma Metasample. The four depression fractures observed at Krapina was significantly more than expected under the null hypothesis at p = 0.04. The one depression fracture observed in the Neandertal trauma Metasample was not significantly smaller than expected under the null hypothesis at p = 0.11, but is a trend. Other weaker trends include the 16 »breaks« (post-cranial fractures) observed in the Neandertal trauma Metasample, which is high at a realized significance of p = 0.29 and the 3 breaks of the Krapina trauma sample, which is low at a realized significance of p = 0.23.

In summary, the null hypothesis that the Neandertal trauma Metasample does not manifest different patterns of trauma than the Neadertals from Krapina is not rejected for regions of the body, side of the body, and sex of the individual displaying trauma. The null hypothesis that the Neandertal trauma Metasample does not manifest a different pattern of trauma than Neandertals was rejected for type of trauma with a significance of p = 0.03.

TABLE 9

Counts of instances of types of trauma observed among bones in the Neandertal trauma Metasample and recovered at Krapina with significant trends (+++ or – – –), weak trends (++ or – –) and very weak trends in smaller (–) or larger (+) counts indicated.

Type of Trauma	Neandertal Trauma Metasample	Trauma at Krapina
Break	16 +	3 –
Depress	1 – –	4 +++
Scalp	3	1
Slash	2	0

TABLE 10

Preservation of bones from each body region at Krapina.

Region of the Body	Total Number of Bone Fragments	Number of bone fragments >25% complete	Percentage of Bones > 25% complete
Head	230	63	27%
Trunk	126	42	33%
Arm	87	25	29%
Hands	70	66	94%
Pelvis	16	1	6%
Leg	86	39	45%
Feet	78	56	72%

DISCUSSION

This paper demonstrated how much and how little may be said for such a small group of rare instances. The smallness of the sample – 15 individuals with 24 instances of trauma for the Neandertal Metasample and eight bones showing trauma at Krapina – makes it difficult to determine with statistical concepts whether a perceived trend is an artifact of sample size, or a difference that would be significant with more data. ACTUS2 displays the effects of the counts in each cell on the overall contingency table significance and measures whether counts in each cell are smaller or larger than might be expected under the hypothesis of randomness. Its power to reject the null hypothesis, however, is still dependent on the size of the sample.

Trauma is rare at Krapina and only appears in two regions of the body: the head and the arms. It is shown in the ACTUS2 analyses that the distribution of trauma throughout the body regions at Krapina is not random (p = 0.002). Arguments that this is merely the artifact of sampling error are rejected by the use of simulating the trauma distributions 10000 times and recording how many times the count for each cell was not greater than or less than the observed count for that cell. It is not only possible to see which regions of the body contain significantly more trauma than expected (the head and arm regions), but also, to get a sense of the regions of the body in which less trauma is observed less than expected, given the number of elements in that region. In the case of trauma within the Krapina sample, the p-values for these regions where less trauma was observed than expected were not significant. There were, however, weak trends toward too few instances of trauma in hands (p = 0.16) and feet (p = 0.22). There might be two explanations for this weak trend. The first explanation is simply that these areas were not injured so frequently as other areas of the body. Given the high state of preservation of the bones of the hands and feet, trauma in these regions it would be expected that trauma would be observed there if present. The second reason might be that, because these elements are smaller (phalanges, metacarpals, metatarsals, carpals and tarsals), more fragments of these bones are found at the more than 25% of the bone preserved level, than in other regions. Because some of these smaller bones are less likely to suffer post-mortem breakage than other bones in the body, they appear more frequently in the counts of bones with no trauma at Krapina at a higher percentage than fragments from other regions of the body and consequently their expected count of trauma is higher than in some of the less well preserved regions.

Although one would not want to include bones that are so fragmentary as to be meaningless —hence the »conservative« 25% complete threshold – excluding some fragments while keeping others does bring with it a preservation bias that could result in the appearance of some of the weak trends.

In comparing the Neandertal trauma Metasample to the Krapina trauma sample, type of trauma was significantly more prevalent in cranial depression fractures at Krapina ($p=0.04$) than in the Neandertal trauma Metasample. The significant difference of elevated Krapina cranial depression fractures might be a function of a higher level of preservation of cranial depression trauma at Krapina. This higher level of preservation at Krapina may be due to higher presence of a group(s) in the demographic bracket at Krapina who are more likely to have experienced trauma especially to the frontal than at any site elsewhere since Krapina is the largest collection from a single Neandertal site. This higher level of cranial depression trauma may be the result of environmental or social conditions at Krapina different from other sites; for example, a larger aggregation of people or more inter or intra-group personal violence. However, this elevated Krapina cranial depression fracture count may also be explained by higher data collection intensity at Krapina than at other collections. Many researchers have studied trauma in Krapina collection *(3, 7, 17, 18, etc.)* for over a hundred years, making it one of the best-documented paleoanthropological collections. It has been shown in other fields *(33),* that if more researchers examine an area, then they are more likely to find more things in that area than are found in similar areas that are less intensely researched. There might also be differences in whether cranial depression fractures are noticed and regarded as trauma equally by every researcher at each site in the Neandertal trauma Metasample.

Although the null hypothesis was not rejected for any of the other parameters of trauma in comparing the Neandertal trauma Metasample to the Krapina sample, a broader view of what is going on might be gleaned from looking at trends. These trends are not statistically significant, but they are discernible and, given the major limitations of the sample sizes, are worth examining. Trends are:

– The slight tendency for the observation of trauma at Krapina to be less frequent among the bones of the trunk and more frequent among the bones of the head and arms;

– The slight tendency that trauma was observed at Krapina more frequently among individuals whose sex could not be determined and more frequently in the Neandertal trauma Metasample among males;

– The trend towards fewer cranial depressions than expected and more antemortem breakage fractures than expected in the Neandertal trauma Metasample and fewer antemortem breakage fractures at Krapina than expected.

If these resulting trends are not due to sampling biases, they might show that the Neandertal trauma Metasample has a higher number of males with antemortem fracture trauma to the postcranial skeleton. Trauma at Krapina is likely to be to the head and observed in individuals whose sex cannot be determined (mostly because of the fragmentary nature of the Krapina sample).

CONCLUSION

Much meaning has been imputed to the scanty fragments that make up the sample of Neandertal trauma over the course of its study, but sample size imposes a real limitation on these interpretations. It is important to avoid inappropriately speculative conclusions over this tiny group of fragments, but some analysis and interpretation is possible with appropriate techniques. The computer program, ACTUS2 allows small samples of qualitative data to be analyzed in statistically rigorous ways.

In this paper, two aspects of the Krapina trauma data were examined. The first aspect was the randomness of the distribution of trauma among the regions of the body sampled by the more complete fragments from Krapina. The null hypothesis of randomness was rejected for this examination and it was shown that the head and arm regions had significantly more trauma than expected by chance. The second aspect of the Krapina trauma data was its comparison to the Neandertal trauma Metasample. The null hypothesis that there is no difference between the patterns of trauma observed at Krapina and in the Neandertal trauma Metasample was not rejected except for the types of trauma where Krapina showed more cranial depression fractures. The inability to reject this null hypothesis for all the other aspects of »patterns of trauma« (region of the body, side and sex) may be a function of the small sample size, may reflect the disparate nature of the Neandertal trauma Metasample or may indicate that no real differences exist.

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