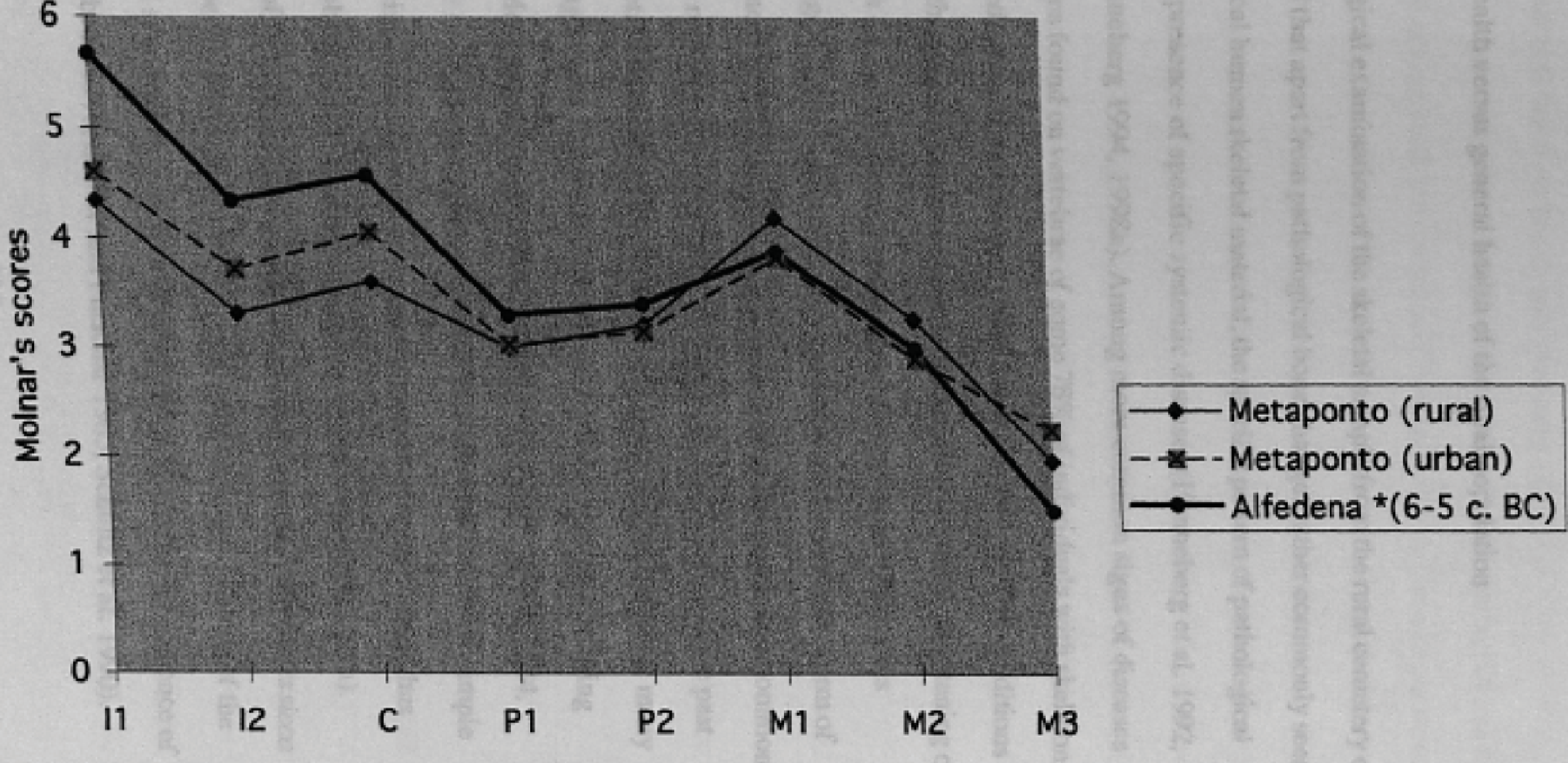
Figure 4.27-5. Tooth wear (Molnar's scores).Comparison between populations. Maxillary dentition. Sexes pooled.




* Macchiarelli & Salvadei 1985

## 4.3. Summary and Conclusion to PART I

### 4.3.1. Dental health versus general health of the rural population

Palaeopathological examination of the skeletal sample from the rural cemetery of Metaponto revealed that apart from pathological bone changes rather commonly seen in most archaeological human skeletal material, the specific pattern of pathological signs suggested the presence of specific systemic diseases (Henneberg et al. 1992, Henneberg and Henneberg 1994, 1998a). Among more common signs of diseases were arthritic changes found on vertebrae of some 78% of individuals with skeletons sufficiently preserved for such observation. Other common pathological conditions included trauma. Pathological changes of bone structure such as porotic thickening of a skull were found in 11 individuals (Henneberg and Henneberg 1998a). This specific type of changes can be induced by various anaemiae. An inherited form of anaemia which produces such changes is called thalassemia. Thalassemia is common in the Mediterranean region and is associated with malaria. Its existence in the past was detected in skeletal series from Greece, Turkey, Cyprus, Egypt and from many parts of Italy including Puglia, Calabria and Lucania, the three regions bordering with Basilicata and Metaponto ( Angel 1966, Menini 1970, Angel 1972a, 1984, Ascenzi and Balisteri 1977, Grmek 1989, Kiple 1995). In the same skeletal sample another systemic and infectious disease with specific pattern of bony changes has been detected (Henneberg et al.1992, Henneberg and Henneberg 1994, 1998a). Sclerotic thickening of the skull, as opposed to the porotic changes, with *caries sicca* on the skull surface, periostitis on long bones, specifically on tibiae, bowing of the tibiae (sabre shin) and specific deformations of tooth enamel, suggest the presence of treponematosis (Steinbock 1976, Ortner and Putschar 1985, Schultz et al. 1990).

The presence of signs of two serious pathological conditions in the rural population represented by a skeletal sample, suggests that they lived in a very stressful environment and that their health was generally poor.

Dental health partially reflected these harsh conditions. The frequency of linear hypoplasia was high among rural Metapontines (78%) and it could be associated with the presence of systemic diseases rather than with common nutritional problems (Neiburger 1990, Wood 1996). The statistically significant difference in the frequency of linear hypoplasia between the entire sample and the group of individuals with bony signs of treponematosis, seems to support that explanation. The colony of Metaponto produced food and exported agricultural crops from which the wealth of the colony was derived (Carter 1990b, Carter 19998). The rural people still hunted wild deer and gathered wild berries. It should not be expected that the people suffered severe food shortages (Costantini 1983, Carter et al. 1985). They also exchanged food with the city improving the variety in their diet with marine components, as it has been shown by analysis of carbon isotopes (Henneberg et al. 1995). The high frequency of dental caries, of periapical abscesses, moderate frequency of periodontitis, often heavy calculus and moderate dental wear, reflect a dental health typical of agriculturists (Hilson 1996, Larsen 1995, 1997).

Within the studied historical period tooth size of the rural Metapontines diminished . This phenomenon may be explained by selective pressures mainly associated with the economy changing from hunter-gathering to mixed, and then to an agricultural one. In the Mediterranean region the reduction in tooth size was rapid (Frayer 1978, McKee 1984, Macchiarelli and Bondioli 1986, Formicola 1987, Calcagno 1989). In the rural sample the trend was possibly enhanced by a change to a more intensive and monocultural type of farming in later centuries (Carter et al.1985, Carter 1992). In contrast there was no substantial increase over time in the frequency of caries, hypoplasia and periodontal disease.

Not all changes associated with agriculture could have been bad for health. Angel (1972b) noticed that improvement in farming, irrigation and drainage of marshes in ancient Greece resulted in decline in porotic hyperostosis associated with anaemia, particularly with thalassemia, from Neolithic times (13%) through middle Bronze age (8%) to Classical times (1%). He assumed that malaria directly linked to thalassemia in the Mediterranean region could also decline. However, later in Hellenistic and Roman Age the increase in malaria was noted in Europe and also in Greece with the rise of the sea level and water tables (Angel 1972b). The same author also observed a parallel increase and decline in longevity associated with diet and climatic changes, and possibly with changes in the pattern of diseases (Angel 1972a). While increase of water tables in Metaponto was confirmed archaeologically (Carter 1998a) no major changes in the frequency of pathological signs on bones, in dental diseases and no change in mortality in the rural population were observed through time (Henneberg 1995, Henneberg and Henneberg 1998a).

4.32. Dental health of the rural population of Metaponto as compared to the urban population

Different patterns of dental diseases were observed in the rural and urban Metapontines. Frequency of caries was higher in the urban population, but carious lesions were rather small and not deep. Dental wear in both populations was similar in its severity and pattern. Frequency of linear hypoplasia was higher among the urban people than in the rural population (78% versus 95%) where it was similar to that in the group with signs of treponematosis. Periodontal conditions were worse in the city than in the rural population. While the city enjoyed greater wealth than the rural people because of trade of agricultural products from the farms, the urban diet was enriched with sugars from expensive honey and other expensive but rich in carbohydrates foods such as some rare and more expensive cereals . That in turn increased caries frequency and incidence. In general, it seems that the dental health of the rural people was slightly better than in the urban population. The higher frequency of linear hypoplasia in the urban population could indicate greater exposure to infectious diseases in crowded urban environment. It could be also expected that the general hygiene in the city was poorer than that in the rural environment . During this historical period, Greek cities had an open sewage system, which was a source of many infectious diseases. The open sewage system could affect the quality of drinking water in the city and increase diarrhoea among children. Diarrhoea is one of the diseases which can affect frequency of linear hypoplasia (Pindborg 1982). Angel (1944) observed that urban Greeks were generally richer than the rural people and could afford to eat more sophisticated and better prepared softer foods than the rural people. He found more crowding and rotations in the urban than in the rural population. According to Angel less selective pressure on the masticatory apparatus because of softer food led to greater frequency of dental anomalies. In Metaponto there was no difference in crowding and rotations between the urban and rural population.

### 4.33. Dental health of the rural population of Metaponto as compared to other Italian and European populations, and world-wide.

Prevalence of dental diseases among rural Metapontines was similar or even higher than among people who lived under the extreme conditions. Frequency of enamel hypoplasia, generally accepted as an indicator of physiological stress, was higher than among 17th-19th century American and Caribbean slaves (Table 4.241-4) (Corruccini et al. 1985, Kelly and Angel 1987). The rural people more often experienced hardships during childhood than hunter-gatherers and than agriculturists from Spanish Florida. They had only slightly lower frequency of hypoplastic rings than nomadic population from Ra's al Hamra-5 in Oman (Table 4.241-4). Recently published data on frequency of hypoplasia among various populations in Italy and world-wide show 80-100% frequency (Table 4.241-4) as a not unusual finding anymore. This high frequency of enamel disturbances is attributed to increased population density and the increased risk of infectious diseases. The classic example of extremely different conditions and similar frequency of enamel hypoplasia came from Roman sites Lucus Feroniae and Portus Romae (Manzi et al. 1997). Slaves in rural environment, and middle class people in the city, experienced similar hardships during childhood. The rural Metapontines had very similar results to these two populations. The most logical explanation for the high frequency of hypoplasia in both rural and urban populations in Metaponto would be the presence of infectious diseases and an increased risk of epidemics in the crowded environment of the city.

Rural Metapontines had high frequency of caries, but it was comparable with many populations of similar economy (Table 4.231-8 and 4.231-9). Frequencies of periodontal disease, periapical abscesses, calculus and dental wear in the rural Metaponto show, in general, similarities to other coeval populations in the region.

High frequencies of enamel hypoplasia in adults in a population are no longer seen as associated with biological disadvantage. Such reaction of the human body is seen rather as an adaptation to the environmental conditions and a proof of survival (Wood 1996). Angel (1972b) suggested similar interpretation of high frequency of porotic hyperostosis in Lerna as an adaptation to malaria.

Findings in the rural and also in the urban populations in Metaponto seem to agree with such interpretations.

## 5. PART II. Affiliations of the people of the rural Metaponto based on dental traits

### 5.1. Introduction

There is enough historical and cultural evidence that the population of Metaponto in the 6th-3rd BC was of Greek culture and most probably of Greek origin (Dunbabin 1948, Boardman 1973, Adamesteanu 1974, 1990, Cartledge 1993, Carter 1990a,b, 1998a). The Greek settlers founded their city in the territory previously occupied by Italic populations. In the archaeological survey of the rural area surrounding the city, Greek pottery and other artefacts either produced in mainland Greece or Greek in style, were found in large quantities along with the artefacts produced by local people (Carter 1990, 1998c). Rural burial grounds were used by people who, in majority, buried their dead according to the Greek tradition. Whether those rural people were Greeks or local Italics who adopted the Greek culture remains unclear. Historical documents described various phases of Greek and Italic relationships in Metaponto during the colonial times. Coexistence of both populations in the same territory or in close vicinity to each other, went through friendly and co-operative phases as well as violent and warring phases (Carter 1990b, Descoeudres 1990, Carter 1998c). To what extent the turbulent history of colonisation could influence the biology of the population of the colonists and the colonised remains to be answered.

Despite the abundance of cultural and historical evidence it is even more difficult to tell to what extent the Greek and Italic people in rural Metaponto coexisted biologically. Some of the burials at the rural necropoleis contained artefacts of indigenous and Greek origin (Carter 1990a, 1998a). Was that because the families were already of Greek and Italic mixture or because the Italic or Greek families gradually adopted each others customs and artistic styles without biological mixing? Was the rural population of Metapontines the same as the urban population? Were the people from Metaponto biologically different from other Italic populations surrounding the Greek colonies at the time of Greek expansion in Southern Italy ? Were the Metapontines closely related to their ancestors from Greece?

According to the archaeological and historical evidence, the rural territory of Metaponto was owned by aristocratic families from the city (Adamesteanu 1974, Carter 1998a). The owners often lived on the farms or commuted regularly between the city and the farms. Did the farm owners bury their relatives at the rural cemetery or in the city? Many of the burials at the rural cemetery were of considerable wealth (Carter 1998a). Judging by the style of the burials and the grave goods, without going to a great detail, the rural and urban necropoleis were not much different from each other. Perhaps the biggest difference was observed in the greater number of large and expensive cist tombs found in the urban cemetery, (Carter 1998a). Because there were almost twice as many more females than males buried at the rural necropolis it has been suggested that the most expensive burials at the urban necropolis were used to bury the most important citizens of the Metaponto colony. Among them were owners of the farms, and male members of the Greek society whose families were buried at the rural cemetery (Henneberg and Henneberg 1990b, 1998a). It could be expected that the urban people were even wealthier than their rural neighbours as the city flourished on trade. Unfortunately, the skeletal remains from the part of the urban cemetery with the most elaborate cist tombs were not preserved by early excavators and not available for the study.

Some of the questions related to the affiliations of the rural Metapontines could be answered by comparing biological metric and non-metric dental characteristics between populations and testing the following hypotheses:

1) If the Greek colonists lived on the farms and buried their dead at the rural cemetery their biological characteristics should not be different from those of the urban people.

2) An alternative hypothesis would be that the people buried at the rural necropoleis were mostly local Italics or servants who were assimilated into the Greek culture but biologically closer to Italic populations in this region.

3) If the Greek colonists influenced the local people not only culturally but also biologically, after centuries of cohabitation and possible mixed marriages, their biological

characteristics should be closer to the local population of indigenous people, or should be intermediate between Greeks and the locals.

4) Assuming that the third hypothesis is true, and that the rural people were less mobile than the urban population because of the nature of their occupation, the rural population should show closer biological affinities to the Italics than to the urban population of merchants and traders with closer contacts with Greece.

5) Because Greeks occupied the Mediterranean region for several millennia their biological affinities should be obviously closer to coeval populations in the Mediterranean region than to other populations world-wide. The same should be true for the rural Metapontines when compared to the population from Mediterranean region and world-wide.

## 5.2. Statistical methods

Thirty two metric and 44 non-metric traits of teeth were used to describe biological relatedness between rural and urban Metapontines and between Metapontines and other populations.

Bucco-lingual (BL) and mesio-distal (MD) diameters of permanent teeth for 16 groups were used for calculations of biological distances between populations (Table 5.31-1). Data for left and right sides in each group were pooled together.

Several statistical methods could be applied to test similarities and differences between populations. The biological relatedness or divergence between two populations could be described by means of comparison of their non-metric or metric traits (Sciulli 1979).

The differences between frequencies of non-metric traits on teeth were tested with Chi-squared test. Student's t-test was used to test differences between metric characteristics observed on teeth. Bonferroni statistical procedure was applied to lower the effect of type I error derived from comparisons of many variables from the same population (Miller 1966). The Bonferroni procedure controls overall error rate by setting the error rate for each test of pairwise comparisons to the experimental error rate divided by the total number of tests.

Biological affinities between populations could be described using multivariate methods (Mahalanobis 1930, Penrose 1954, Sjøvold 1973, 1977, Finnegan and Cooprider 1978, Molto 1983, van Vark and Howells 1984). Sets of metric and non-metric skeletal and dental traits were analysed here to calculate values representing general measures of biological distance between populations.

The most accurate multivariate measure of biological distances between populations, based on metric data, is the Mahalanobis's $D^2$ derived from Euclidean distance and corrected for covariances between characters. Calculation of this distance requires a large sample of individual data from compared populations on which covariance matrix has to be calculated (Mahalanobis 1930, van Vark and Howells 1984, Henneberg 1984). In the case of Metaponto the rural and urban dental samples were rather small to construct a reliable covariance matrix. Another reason why this method was not chosen is that most of the comparative data from the literature were presented as mean values and standard deviations while individual data for calculation of covariance matrices were not available.

It could be debated which of the multivariate methods based on the mean values for calculation of biological distances would give the most objective result (van Vark and Howells 1984, Henneberg 1984). Most of the methods do not eliminate all factors influencing the results simply because of the nature of the biological characteristics and the nature of archaeological samples used for comparisons. Thus, the results obtained with any of them should be interpreted with caution (Sounders 1989, Larsen 1997).

The multivariate method of Penrose's generalised distance was chosen to calculate biological distances between the urban and rural populations from Metaponto and between Metapontines and other populations world-wide (Penrose 1954, Henneberg 1984, Steyn and Henneberg 1997).

The Penrose's generalised distance contains two components called shape and size. The generalised distance value corrected for size was used as the total measure of divergence between populations. The results were tested for the statistical significance using error estimates for computing confidence interval limits (Henneberg 1984).

The generalised distance was calculated according to the formula (after Henneberg 1984 and Steyn and Henneberg 1997):

$$C^2{}_p = C^2{}_H - C^2{}_Q$$

where $C^2{}_H = (\Sigma d^2)/N$ and $C^2{}_Q = (\Sigma d)^2/N$.

$C^2{}_p$ - generalised Penrose's distance
$C^2{}_H$ - shape distance
$C^2{}_Q$ - size distance,
d - difference between means of a particular character in two compared samples, divided by a standard deviation of this character
N - number of compared characters.

The component called shape ($C^2{}_H$) is the geometrical representation of morphological characteristics which, in case of teeth most probably include characteristics such as the shape of individual teeth (proportion of various diameters to each other), metrical proportions of individual teeth in relation to each other in the single set of teeth, and the actual size of the teeth. The component called size ($C^2{}_Q$) is the geometrical representation of size, thus it most probably represents the tooth diameters alone. The difference in tooth size between the compared populations is removed by calculation of the generalised Penrose's distance ($C^2{}_p$).

This method standardises for size and then, in case of dental samples from Metaponto, has two advantages. Standardisation for tooth size eliminates or at least diminishes the influence of evolutionary changes in tooth size which occurred over time as it was reported for populations in the Mediterranean region (Frayer 1978, Calcagno 1986, Macchiarelli and Bondioli 1986a,b, Formicola 1987). At least theoretically, the method also allows for combining the data for females and males together and broaden the possibility of comparisons with data from the literature where often tooth size means are presented only for both sexes combined (Carr 1960, Tal and Smith 1981, Lukacs and Hemphill 1991, Macchiarelli et al. 1995).

In order to justify further the use of data for both sexes combined the Penrose's generalised distance was calculated between female and male samples from Metaponto.

The author is aware of the fact that the proportion of females and males in the sample from any population may distort the results of a comparison between two samples with sexes combined despite the standardisation for size. Unfortunately, in many of the dental samples available for comparisons the proportion of female and male teeth in the sample is unknown (mostly loose teeth in the sample not associated with the rest of the skeleton) or there is unequal number of males and females in the sample excavated from the site.

In order to present the results as objectively as possible and for their careful interpretation the Penrose's generalised distances were calculated for females and males separately where possible and for sexes combined to enlarge the number of available comparisons with dental samples from populations world-wide.

Mean values and standard deviations are used to calculate the Penrose's generalised distance instead of individual measurements, thus making the method simple and easy to apply. This procedure also allows comparisons with wide range of populations for majority of which only the mean values were published.

The method does not address the problem of inter-correlation between variables, thus the inter-correlation between dental diameters within an individual dental arcade may enhance the results of biodistances between compared populations. In practice, only Mahalanobis's $D^2$ method based on individual measurements includes appropriate corrections. Other methods either only partially eliminate the influence of inter-correlation or, as Mahalanobis's $D^2$, require individual data for comparisons and are much more complicated in use than the Penrose's generalised distance method without being completely free of problems (van Vark and Howells 1984, Brace et al. 1984, 1991, Larsen 1997).

Because of the nature of the archaeological material from Metaponto, the availability of comparative data and of its simplicity the Penrose's generalised distance seems to be an optimal method for assessing the biological affinities in this study, despite its shortcomings.

Both bucco-lingual (BL) and mesio-distal (MD) diameters are usually used in calculations of biological distances with multivariate methods. However, the breadth measurement is regarded more reliable for interpopulational comparisons because it is less affected by dental wear (Frayer 1978). While dental wear is known and it is similar for both the rural and urban samples from Metaponto (Figure 4.27-4 and 4.27-5), for most of the other populations used for comparison in the thesis the dental wear is unknown thus, its effect on tooth size is difficult to assess. In this situation the use of only bucco-lingual measurements in the calculations seems to be a logical choice for most of the comparisons.

To pre-empt any dispute whether only BL or both BL and MD measurements should be used in the calculation of biological distances, in this study Penrose's generalised distances were calculated twice for each pair of compared populations depending on availability of the data. In the first calculation only BL measurements of all teeth were used for comparisons. The second set of data, used for calculation of distances included both BL and MD measurements of all teeth. In both calculations measurements from the left and the right side of the jaw were pooled together. In other comparisons the data for females and males and from both sides of the jaw were treated either separately or jointly. Dental samples from other populations were selected according to their geographical location, time and sample size. Samples from the sites dated to similar time as Metaponto and of considerable size, from Italy and from the Mediterranean region were the main data used for comparisons. To contrast the results of comparisons within the Mediterranean region, dental samples from various locations around the world and from various times in history were also compared with the dental sample of rural Metapontines.

The multivariate Mean Measure of Divergence (MMD) was used to compare the non-metric trait frequencies between populations (Berry and Berry 1972, Sjøvold 1973). The procedure for calculating MMD, its variance, standard deviation and standardised MMD values was adopted after Johnson and Lovell (1994). The frequencies of traits were first angularly transformed according to the procedure recommended for small sample sizes (Green and Suchey 1976, after Johnson and Lovell 1994).

The formula for arscine transformation was:

$$\Theta = 1/2 \sin^{-1} ( 1 - 2 k/(n+1)) + 1/2 \sin^{-1} ( 1 - 2 (k+1)/(n+1))$$

where: k = the observed frequency of the trait,
n = the number of individuals for which the observation of the trait was possible.

The MMD value was calculated as follows:

$$MMD = (1/r)\sum_{i=1}^{r}(\Theta_{1i} - \Theta_{2i})^2 - ((1/(n_{1i} + 0.5)) + 1/(n_{2i} + 0.5))$$

$\Theta_i$ = the angular transformation of the sample for the $i^{th}$ trait
$n_{1i}$ and $n_{2i}$ = the number of individuals observed for $i^{th}$ character in samples 1 and 2

$$Var_{MMD} = (2/r^2)\sum(1/(n_{1i} + 0.5)) + (1/(n_{2i} + 0.5))^2$$

$Var_{MMD}$ = variance of MMD
$SD_{MMD} = \sqrt{Var_{MMD}}$
$SD_{MMD}$ - standard deviation

The variance and the standard deviation were calculated according to the method of Sjøvold (1973, after Johnson and Lovell 1994). Standardised MMD values were recommended instead of MMD values as they provide better evaluation of relative distances between samples of different sizes (Sofaer et al. 1986). These were calculated by dividing the MMD value by its standard deviation. Standardised value greater than 2.0 indicated a significant difference at the 0.05 level (Sjøvold 1973).

## 5.3. Results and interpretation

### 5.31. Dental metrics

Mean values, standard deviations and sample sizes for bucco-lingual (BL) and mesio-distal (MD) measurements for each tooth category in the rural population of Metaponto (sides combined) are shown in Table 5.31-1. Measurements of dental diameters for a comparative urban sample are presented in Table 5.31-2.

The results of Student's t-test comparisons of dental measurements mean values for females and males from the rural sample are shown in Table 5.31-1a. All 32 dental diameters of females were smaller than those of males clearly showing the direction of the size difference between sexes. However, the statistically significant differences in tooth size between sexes occurred only for fifteen characteristics. When the Bonferroni procedure was applied by adjusting the probability level, the number of statistically significant differences dropped to six. All six differences between sexes were in the bucco-lingual diameters. The results have demonstrated that the females had smaller teeth than males in this dental sample but the differences between sexes were also rather small.

The Penrose's generalised distance was calculated for mean values of females and males from the same rural sample as tested with the Student's t-test. The value of the $C^2_p$ was small (0.042) and was not statistically significantly different from zero. The result suggested that besides sheer size there is no difference between females and males in the set of metric characteristics used. To demonstrate further that size presented as linear measurements does not influence the Penrose's generalised distance the mean values of dental diameters for females were diminished by 0.2 mm each and then the distance between the females and the males was calculated again. The result of the second calculation of the $C^2_p$ was similar to the previous one (0.043) and also not statistically significant. Lack of the significant Penrose's generalised distance between the females and males of the same population which differed significantly in the size of their teeth, indicates that the calculation of the Penrose's generalised distance eliminates the influence of overall size differences while comparing geometry of dental metrics (Tables 5.31-1a and 5.31-1b). These results justified the use of this multivariate procedure to samples where data for both sexes were combined.

The results of calculation of Penrose's generalised distances between various populations (sexes combined) including rural-urban comparison are presented in the Table 5.31-3 and Table 5.31-3A. Examples of calculations of the Penrose's generalised distances for a pair of compared populations and the statistical tests of the calculated distances are presented in the Tables 5.31-10 and 5.31-10A.

The distance between the rural and urban populations measured with Penrose's generalised distance for 16 bucco-lingual (BL) dimensions was statistically significant (Table 5.31-3). The Penrose's distances calculated for the rural Metapontines and coeval populations from Alfedena in the central part of Italian peninsula and from Pontecagnano (near Salerno) were not statistically significant. The rural population from Metaponto also did not differ from the earlier Italic populations from Sala Consilina (Salerno) and Osteria dell'Osa (near Rome) and from populations dated later than Metaponto from Lucus Feroniae and Portus Romae (both near Rome) as indicated by not statistically significant Penrose's distances. Statistically significant Penrose's generalised distance was found between the rural people from Metaponto and Minoans from Cnossos (Crete) whose culture influenced first Myceneans and then Greeks. There was a time difference of a millennium between both samples.

Among Penrose's generalised distances calculated for the rural sample from Metaponto and 21 other populations, and based only on BL measurements, the distances between all six populations from Italy and the rural Metapontines were not statistically significant.

The rural Metapontines were distant from most of the populations chosen for comparisons from parts of the world other than the Italian peninsula. The Penrose's distances seemed to reflect well the geographical location of the compared populations and the differences in time between them (Table 5.31-3, and Table 5.31-3A.).

The distance between the rural and the urban populations measured with Penrose's generalised distance based on 32 dental dimensions (BL and MD combined) was not statistically significant (Table 5.31-3A) although its numerical value was not much smaller than that for the distance based on BL dimensions only. The distances between the rural Metapontines and two coeval populations from Alfedena and Pontecagnano in Italy were not statistically significant. The distances were also insignificant between the rural population and the two 2nd century Roman populations from Lucus Feroniae and Portus Romae. These results were in agreement with previously obtained results when using only BL measurements in calculations. The distances between the rural Metaponto and the two earlier populations, the 9th-7th century Osteria dell Osa and Sala Consilina based on 32 metric characteristics were statistically significant (Table 5.31-3A). This result was opposite to that when only BL measurements were used in calculations of distances.

The rural Metapontines were close to the Sarai Khola population from Pakistan dated to the 3 c. BC as it was indicated by the not statistically significant Penrose's generalised distance. The distance was not significant whether only 16 BL diameters or all 32 BL and MD measurements were used for distance calculations (Table 5.31-3 and Table 5.31-3A). Perhaps this result was an accidental one because the sample from the Sarai Khola site is smaller than others used for comparisons and could represent an extreme fraction of a large population. On the other hand, the Greek language belongs to the group of Indo-European languages, and Greeks were believed to come to the Mediterranean region from the unidentified place between Caucasus, India, Iran and Europe (Boardman et al. 1991). Thus, the close relationship of the rural Metapontines to the people from Sarai Khola could have some biological explanation. This interpretation, however, should be approached very cautiously.

Another unexpected result was obtained for the comparison between rural Metapontines and Mediaeval Swedes when calculations were based on 16 BL measurements (Table 5.31-3). The Penrose's distance was not statistically significant. The distance became significant and somewhat greater when both BL and MD measurements were used in the Penrose's method (Table 5.31-3A). Close similarity between those two geographically isolated populations who lived almost two millennia apart, shown by the Penrose's generalised distance, could be a reflection of microevolutionary changes in Europe. It was well documented that the teeth of various populations, and in particular among Europeans and in the Mediterranean region became smaller through time (LeBlanc and Black 1974, Frayer 1978, McKee 1984, Macchiarelli and Bondioli 1986, Formicola 1987, Calcagno 1986, 1989, Brace et al. 1991). Greater distance observed between the rural Metapontines and Mediaeval Swedes after including MD measurements into calculations of Penrose's distances supports the notion of microevolutionary changes. These changes probably embraced not only changes in size but in tooth shape and the metric proportions between the teeth in the individual dental arcade because the calculation of the Penrose's generalised distance included standardisation for size as it was shown above.

Other explanations could be feasible. The microevolutionary changes in tooth size were particularly fast in the Mediterranean region (Macchiarelli and Bondioli 1986, Formicola 1987). Even if the reduction in tooth size slowed down with intensive agriculture, as shown in Nubia (Calcagno 1989), the ongoing process could compensate for the "time difference" between populations with slower and faster microevolutionary changes. The similar processes could take place concerning the evolutionary changes in tooth shape and other characteristics. Then it would show that populations were close biologically when in fact they differed and were at different stages of microevolutionary changes. However, the tooth wear factor influencing the MD dimensions, and thus influencing the results cannot be totally excluded as responsible for the discrepancies in results from both calculations, because populations may differ in patterns of dental wear.

Irrespective of their significance, all Penrose's generalised distances were numerically small indicating only slight differences in dental dimensions between populations.

The Penrose's generalised distances were also calculated separately for females and males and the results are presented in Tables 5.31-4 and 5.31-4A and Tables 5.31-5 and 5.31-5A respectively.

There was no statistically significant difference between males from the rural and urban populations while the Penrose's generalised distance was statistically significant between the rural and urban females when based on 16 BL measurements. The rural males did not differ from males from the four indigenous samples from Italy. They seemed to be related to males from the coeval sites of Alfedena and Pontecagnano and, to 2 c. BC Portus Romae and Lucus Feroniae. As in the total dental sample, the rural males did not show difference from Mediaeval Swedes but were distant from Mesolithic Yugoslavs and earlier Chinese (Table 5.31-5, Table 5.31-5A). The rural females were closely related to three of the Italian samples but were statistically significantly distant from the females from Lucus Feroniae when only the BL diameter was used for comparisons. According to the archaeological evidence, the Lucus Feroniae sample consisted of generally poor people believed to be manual workers, slaves and servants (Manzi et al. 1997) and who could have come from a very distant area of the Roman Empire. The females differed from the Chinese, the Mesolithic Yugoslavs and also from Mediaeval Swedes. The distance between the rural and the urban females from Metaponto was not statistically significant when based on both BL and MD measurements.

The distances between the rural females and other Italian populations became statistically significant when the Penrose's generalised distances were based on both BL and MD measurements. Males remained close to most of the Italian populations where the distances were based on both BL and MD measurements. They showed a greater distance to the coeval population from Alfedena when the calculation of the distance was based on BL and MD measurements as opposed to the non significant distance based only on BL diameters. Macchiarelli and Salvadei (1985) showed that the people from Alfedena had their anterior dentition worn disproportionately faster than the posterior dentition. The wear of anterior teeth was also faster than in other coeval populations. The authors suggested that the teeth were used as tools. This unusual dental wear pattern could explain the significantly greater distance between the rural females and females from Alfedena and between the rural males and males from this archaeological site when distances were based on both BL and MD measurements.

This observation suggests that indeed, the BL measurements are more reliable for comparisons between populations.

In addition to the Penrose's distance, the females' and males' mean values of tooth diameters for the entire dental samples were compared between the rural and urban populations (Tables 5.31-6 and 5.31-7). The urban females had generally smaller teeth than the rural females. The results of comparisons between mean values for 32 dental characteristics (16 BL and 16 MD diameters in 16 tooth classes) were statistically significant for 22 characteristics as tested with Student t-test. Among them 21 differences indicated smaller diameters in the urban females (Table 5.31-6). When the Bonferroni protection procedure was used setting the error rate to the error value divided by 32 comparisons, then the number of statistically significant differences in tooth diameters between the rural and urban females dropped to nine, with six significant differences in the bucco-lingual diameters. All nine significant differences indicated smaller teeth in the urban females. The urban males also had smaller teeth than the rural males but only in 10 among 32 characteristics were the differences statistically significant. When the Bonferroni procedure was applied accepting as significant differences at the $<0.001$ confidence level, then there was no difference in tooth size between rural and urban males. This may be a reflection of smaller sample sizes for males. All of the statistically significant differences in males indicated smaller tooth diameters in the urban males (Table 5.31-7).

The entire rural dental sample was divided into two sub-groups A (7th-5th c.BC) and B (4th-3rd c. BC) according to burial dating and sex. Mean values and standard deviations were calculated for 64 characteristics separately for A and B time groups and for each sex and then compared between A and B groups. The statistical significance of the differences was tested with the Student t-test (Tables 5.31-8 and 5.31-9). The Bonferroni statistical procedure to control an overall error was also applied.

Both females and males showed changes through time in the tooth size. Females showed more changes than males. Among the 64 compared characteristics (teeth from the left and right side compared separately), 53 differences between A and B groups of females suggested that teeth became smaller with time by up to about 8% of their size, but only 9 differences in tooth diameters were statistically significant (Table 5.31-8). Among males 37 differences between tooth diameters from A and B groups indicated changes towards smaller teeth with time but only two of these differences were statistically significant (Table 5.31-9). The less significant changes in tooth size through time among the rural males than in the rural females, could be due to a much smaller sample size for males than females, but other explanations were also explored. In both sexes the differences in tooth size through time disappeared when stricter criteria of the Bonferroni procedure were used to control the possible error.

The Penrose's generalised distances were calculated separately for sub-samples of rural females from burials dated to the 7th-5th c. BC and to the 4th-3rd c. BC and for the urban females (Table 5.31-4 and Table 5.31-4A). The rural sub-sample of females from 7th-5th c. BC was statistically significantly distant from the urban females, while the sub-sample of females from later dated burials was closely related to the urban neighbours. The results were the same for both time sub-samples whether the calculations were based only on BL diameters or on both BL and MD measurements. Since there was no differene among males and the male sample was small no Penrose's distances were calculated for sub-samples of males.

It seems that the microevolutionary changes in tooth size, however small, were already observable in the rural population in the relatively short time of three centuries, if the results of the Bonferroni test were ignored. Other explanations of the differences between the two time groups could not be excluded. It is possible that the earlier colonists freely mixed with the local Italic people while later the contacts ceased. This explanation could be supported by greater Penrose's generalised distances (standardised for size) between rural and urban females and the lack of differences between rural and urban males. According to Spence (1974), who studied residential patterns in urban Teotihuacan (Mexico), females displayed greater variability than males because they came from outside the territory of the male population. In the case of Metaponto it could be also true that the rural families had greater numbers of female servants and slaves who were buried together with the owners of the land. The servants and slaves could have come from local and also from very distant groups. Historical sources suggest that until the end of the 5th century Metapontines had rather friendly relationships with indigenous people. Instead, the city participated in Greek political conflicts supporting Athens in the Peloponnesian War as the only Greek colony of Magna Grecia (Carter 1998a). In the fourth century BC Metaponto was at war with neighbouring indigenous groups and then in the third century BC with Romans. As the result of the complicated politics, in the fourth century BC Metaponto was punished for its support of Athens by the victorious Cleonymus of Sparta who invited the local Lucanians into the Metaponto territory (Carter 1998a). If the migratory element in the chora was the males, it is interesting that there were no differences in dental characteristics between urban and rural males and also no difference through time.

The lack of the difference in the size of teeth and other characteristics described by Penrose's generalised distance between the rural and urban males could have yet another explanation. The sex ratio of females and males at the entire rural cemetery Pantanello used over three centuries, was statistically significantly different from the biologically expected 1:1 ratio (Henneberg and Henneberg 1990b, 1998a). Almost twice as many females as males were buried at the rural cemetery (1.88 females to one male). Similarly, imbalanced sex ratio towards a greater number of females (1.83:1), statistically significantly different from the biologically expected 1:1 ratio, was found in the skeletal sample preserved from the urban cemetery Crucinia (Henneberg et al. in preparation). The missing part of the male population from both urban and rural samples could have been buried in the more elaborate tombs from which the skeletons were not available for anthropological examination. According to the classical archaeologists the elaborate cist tombs were used for burials more often in the earlier centuries than later during the existence of the Greek colony in Metaponto (Carter 1998). If the Greek owners of the farms were buried in the city in these tombs, the remaining male population in the rural necropoleis in the earlier centuries (7th-5th c. BC) could have been of a mixed Greek and Italic origin. It has already been mentioned that in the earlier period of colonisation there was enough evidence to support the view of friendly relationships between the Greek colonists and the indigenous people in the chora (Adamesteanu 1990, Carter 1998c). Migration of Lucanians to the city in the 4th century BC enriched the urban population with local biological element. Thus, the lack of differences in the tooth size and other characteristics described by the Penrose's generalised distance between the rural and urban males within the span of the three centuries could be a result of at least two processes. The effect of selective archaeological practices was superimposed on the natural biological contacts between the local people and the colonists in the first period of the history of the rural Metaponto. This resulted in the partially artificial increase of the local component in the rural sample of males. The migration of the local people to the city, biological contacts between populations, and the artificial effect of selective archaeological practices, would result in counterbalancing the differences or changes in the tooth size and shape between rural and urban males from the later period of Metaponto history.

On the contrary, clear difference was found in the tooth size between the rural and urban females and the dentition of the rural females suggested changes through time (Tables 5.31-6 and 5.31-8). Moreover, in the second part of the Metaponto history the rural females seemed to be more closely related to the females from the city than in the earlier centuries of colonisation as shown by the results of the Penrose's generalised distance where influence of tooth size was eliminated (Table 5.31-4A). The disappearance of differences in dental metrics between the rural and the urban females with time could be an expected result of mixing of the local and the colonist gene pools. Thus, the characteristics of the females in Metaponto, rather than males, could reflect the process of integration of the local people and the colonists over the centuries of colonisation in this region.

**TABLES**

**Table 5.31-1.** Tooth measurements: BL (bucco-lingual) and MD (mesio-distal) diameters. Rural Metaponto (Pantanello, Saldone, Sant'Angelo).
Right and left sides combined.

**Females**

| | BL | | | MD | | |
|---|---|---|---|---|---|---|
| **Tooth** | **N** | **x** | **s** | **N** | **x** | **s** |
| UI1 | 72 | 7.21 | 0.46 | 70 | 8.46 | 0.50 |
| UI2 | 71 | 6.38 | 0.47 | 69 | 6.52 | 0.57 |
| UC | 94 | 8.17 | 0.51 | 92 | 7.48 | 0.46 |
| UP1 | 98 | 8.65 | 0.55 | 95 | 6.56 | 0.43 |
| UP2 | 99 | 8.93 | 0.55 | 96 | 6.50 | 0.44 |
| UM1 | 93 | 11.24 | 0.52 | 88 | 10.17 | 0.61 |
| UM2 | 98 | 10.94 | 0.57 | 93 | 9.40 | 0.63 |
| UM3 | 52 | 9.97 | 1.09 | 52 | 8.76 | 1.10 |
| LI1 | 66 | 6.06 | 0.43 | 65 | 5.32 | 0.40 |
| LI2 | 72 | 6.33 | 0.46 | 71 | 5.90 | 0.52 |
| LC | 115 | 7.62 | 0.55 | 108 | 6.63 | 0.46 |
| LP1 | 114 | 7.50 | 0.55 | 111 | 6.70 | 0.56 |
| LP2 | 98 | 7.92 | 0.58 | 99 | 6.93 | 0.46 |
| LM1 | 80 | 10.46 | 0.46 | 82 | 10.90 | 0.71 |
| LM2 | 108 | 10.01 | 0.61 | 106 | 10.50 | 0.67 |
| LM3 | 75 | 9.75 | 0.80 | 74 | 10.34 | 1.10 |

**Males**

| | | | | | | |
|---|---|---|---|---|---|---|
| UI1 | 34 | 7.26 | 0.46 | 34 | 8.56 | 0.64 |
| UI2 | 40 | 6.41 | 0.45 | 38 | 6.63 | 0.55 |
| UC | 47 | 8.40 | 0.63 | 45 | 7.60 | 0.53 |
| UP1 | 51 | 9.01 | 0.50 | 53 | 6.80 | 0.42 |
| UP2 | 53 | 9.16 | 0.54 | 54 | 6.71 | 0.44 |
| UM1 | 50 | 11.65 | 0.53 | 52 | 10.44 | 0.58 |
| UM2 | 49 | 11.40 | 0.75 | 48 | 9.70 | 0.82 |
| UM3 | 48 | 10.89 | 0.95 | 46 | 9.08 | 0.95 |
| LI1 | 42 | 6.14 | 0.46 | 36 | 5.43 | 0.48 |
| LI2 | 38 | 6.49 | 0.46 | 33 | 6.01 | 0.48 |
| LC | 65 | 7.95 | 0.54 | 62 | 6.75 | 0.47 |
| LP1 | 65 | 7.78 | 0.53 | 60 | 6.74 | 0.50 |
| LP2 | 56 | 8.19 | 0.53 | 54 | 7.07 | 0.51 |
| LM1 | 53 | 10.62 | 0.55 | 47 | 11.02 | 0.65 |
| LM2 | 61 | 10.35 | 0.64 | 58 | 10.79 | 0.71 |
| LM3 | 39 | 10.04 | 0.73 | 40 | 10.59 | 0.80 |

N- number of teeth, x - average, s - standard deviation

**Table 5.31-1a.** Comparison of tooth size between females and males from rural Metaponto. BL (bucco-lingual) and MD (mesio-distal) measurements.

| | A. Females | | | B. Males | | | | |
|---|---|---|---|---|---|---|---|---|
| **Tooth** | **N** | **x** | **s** | **N** | **x** | **s** | **t-test** | **level** |
| **BL** | | | | | | | | |
| UI1 | 72 | 7.21 | 0.46 | 34 | 7.26 | 0.46 | -0.5174 | ns |
| UI2 | 71 | 6.38 | 0.47 | 40 | 6.41 | 0.47 | -0.3199 | ns |
| UC | 94 | 8.17 | 0.51 | 47 | 8.4 | 0.63 | -2.312 | >0.05 |
| UP1 | 98 | 8.65 | 0.55 | 51 | 9.01 | 0.5 | -3.8825 | >0.001 |
| UP2 | 99 | 8.93 | 0.55 | 53 | 9.16 | 0.54 | -2.4562 | >0.05 |
| UM1 | 93 | 11.24 | 0.52 | 50 | 11.65 | 0.53 | -4.4346 | >0.001 |
| UM2 | 98 | 10.94 | 0.57 | 49 | 11.4 | 0.75 | -4.1076 | >0.001 |
| UM3 | 52 | 9.97 | 1.09 | 48 | 10.89 | 0.95 | -4.4383 | >0.001 |
| LI1 | 66 | 6.06 | 0.43 | 42 | 6.14 | 0.46 | -0.9086 | ns |
| LI2 | 72 | 6.33 | 0.46 | 38 | 6.49 | 0.46 | -1.7189 | ns |
| LC | 115 | 7.62 | 0.55 | 65 | 7.95 | 0.54 | -3.8702 | >0.001 |
| LP1 | 114 | 7.5 | 0.55 | 65 | 7.78 | 0.53 | -3.3002 | >0.01 |
| LP2 | 98 | 7.92 | 0.58 | 56 | 8.19 | 0.53 | -2.8476 | >0.01 |
| LM1 | 80 | 10.46 | 0.46 | 53 | 10.62 | 0.55 | -1.801 | ns |
| LM2 | 108 | 10.01 | 0.61 | 61 | 10.35 | 0.64 | -3.3981 | >0.001 |
| LM3 | 75 | 9.75 | 0.8 | 39 | 10.04 | 0.73 | -1.8745 | ns |
| **MD** | | | | | | | | |
| UI1 | 70 | 8.46 | 0.5 | 34 | 8.56 | 0.64 | -0.8618 | ns |
| UI2 | 69 | 6.52 | 0.57 | 38 | 6.63 | 0.55 | -0.9581 | ns |
| UC | 92 | 7.48 | 0.46 | 45 | 7.6 | 0.53 | -1.3526 | ns |
| UP1 | 95 | 6.56 | 0.43 | 53 | 6.8 | 0.42 | -3.2603 | >0.01 |
| UP2 | 96 | 6.5 | 0.44 | 54 | 6.71 | 0.44 | -2.787 | >0.01 |
| UM1 | 88 | 10.17 | 0.61 | 52 | 10.44 | 0.58 | -2.5584 | >0.01 |
| UM2 | 93 | 9.4 | 0.63 | 48 | 9.7 | 0.82 | -2.3926 | >0.01 |
| UM3 | 52 | 8.76 | 1.1 | 46 | 9.08 | 0.95 | -1.5158 | ns |
| LI1 | 65 | 5.32 | 0.4 | 36 | 5.43 | 0.48 | -1.2184 | ns |
| LI2 | 71 | 5.9 | 0.52 | 33 | 6.01 | 0.48 | -1.0185 | ns |
| LC | 108 | 6.63 | 0.46 | 62 | 6.75 | 0.47 | -1.6147 | ns |
| LP1 | 111 | 6.7 | 0.56 | 60 | 6.74 | 0.5 | -0.4598 | ns |
| LP2 | 99 | 6.93 | 0.46 | 54 | 7.07 | 0.51 | -1.7191 | ns |
| LM1 | 82 | 10.9 | 0.71 | 47 | 11.02 | 0.65 | -0.9449 | ns |
| LM2 | 106 | 10.5 | 0.67 | 58 | 10.79 | 0.71 | -2.5785 | >0.01 |
| LM3 | 74 | 10.34 | 1.1 | 40 | 10.59 | 0.8 | -1.2564 | ns |

N - number of teeth, x - average, s - standard deviation

**Table 5.31-1b**. Penrose's distance between females (A) and males (B) in rural Metaponto.
BL and MD diameters.

| trait | pop. A | pop. B | SD | Size | Shape | Total | | |
|---|---|---|---|---|---|---|---|---|
| I1 Max - BL | 7.21 | 7.26 | 0.46 | 0.1493 | 0.1909 | 0.0416 | -0.1087 | 0.0118 |
| I2 | 6.38 | 6.41 | 0.47 | | | | -0.06383 | 0.0041 |
| C | 8.17 | 8.4 | 0.51 | | | | -0.45098 | 0.2034 |
| P1 | 8.65 | 9.01 | 0.55 | | | | -0.65455 | 0.4284 |
| P2 | 8.93 | 9.16 | 0.55 | | | | -0.41818 | 0.1749 |
| M1 | 11.24 | 11.65 | 0.52 | | | | -0.78846 | 0.6217 |
| M2 | 10.94 | 11.4 | 0.57 | | | | -0.80702 | 0.6513 |
| M3 | 9.97 | 10.89 | 1.09 | | | | -0.84404 | 0.7124 |
| I1 Mand - BL | 6.06 | 6.14 | 0.43 | | | | -0.18605 | 0.0346 |
| I2 | 6.33 | 6.49 | 0.46 | | | | -0.34783 | 0.121 |
| C | 7.62 | 7.95 | 0.55 | | | | -0.6 | 0.36 |
| P1 | 7.5 | 7.78 | 0.55 | | | | -0.50909 | 0.2592 |
| P2 | 7.92 | 8.19 | 0.58 | | | | -0.46552 | 0.2167 |
| M1 | 10.46 | 10.62 | 0.46 | | | | -0.34783 | 0.121 |
| M2 | 10.01 | 10.35 | 0.61 | | | | -0.55738 | 0.3107 |
| M3 | 9.75 | 10.04 | 0.8 | | | | -0.3625 | 0.1314 |
| I1 Max - MD | 8.46 | 8.56 | 0.5 | | | | -0.2 | 0.04 |
| I2 | 6.52 | 6.63 | 0.57 | | | | -0.19298 | 0.0372 |
| C | 7.48 | 7.6 | 0.46 | | | | -0.26087 | 0.0681 |
| P1 | 6.56 | 6.8 | 0.43 | | | | -0.55814 | 0.3115 |
| P2 | 6.5 | 6.71 | 0.44 | | | | -0.47727 | 0.2278 |
| M1 | 10.17 | 10.44 | 0.61 | | | | -0.44262 | 0.1959 |
| M2 | 9.4 | 9.7 | 0.63 | | | | -0.47619 | 0.2268 |
| M3 | 8.76 | 9.08 | 1.1 | | | | -0.29091 | 0.0846 |
| I1 Mand - Md | 5.32 | 5.43 | 0.4 | | | | -0.275 | 0.0756 |
| I2 | 5.9 | 6.01 | 0.52 | | | | -0.21154 | 0.0447 |
| C | 6.63 | 6.75 | 0.46 | | | | -0.26087 | 0.0681 |
| P1 | 6.7 | 6.74 | 0.56 | | | | -0.07143 | 0.0051 |
| P2 | 6.93 | 7.07 | 0.46 | | | | -0.30435 | 0.0926 |
| M1 | 10.9 | 11.02 | 0.71 | | | | -0.16901 | 0.0286 |
| M2 | 10.5 | 10.79 | 0.67 | | | | -0.43284 | 0.1873 |
| M3 | 10.34 | 10.59 | 1.1 | | | | -0.22727 | 0.0517 |

**Table 5.31-2.** Tooth measurements: BL (bucco-lingual) and MD (mesio-distal) diameters. Urban Metaponto (Crucinia). Right and left sides combined.

**Females**

| | BL | | | MD | | |
|---|---|---|---|---|---|---|
| **Tooth** | **N** | **x** | **s** | **N** | **x** | **s** |
| UI1 | 45 | 6.72 | 0.42 | 42 | 8.14 | 0.66 |
| UI2 | 42 | 5.95 | 0.58 | 41 | 6.32 | 0.68 |
| UC | 68 | 7.91 | 0.51 | 67 | 7.40 | 0.31 |
| UP1 | 64 | 8.55 | 0.61 | 63 | 6.48 | 0.45 |
| UP2 | 60 | 8.64 | 0.51 | 59 | 6.33 | 0.45 |
| UM1 | 69 | 10.99 | 0.52 | 70 | 9.80 | 0.50 |
| UM2 | 61 | 10.78 | 0.66 | 59 | 8.82 | 0.86 |
| UM3 | 48 | 10.44 | 0.96 | 49 | 8.44 | 0.92 |
| LI1 | 53 | 5.69 | 0.47 | 52 | 5.06 | 0.44 |
| LI2 | 63 | 6.18 | 0.44 | 63 | 5.63 | 0.47 |
| LC | 76 | 7.44 | 0.53 | 76 | 6.44 | 0.37 |
| LP1 | 69 | 7.35 | 0.51 | 69 | 6.58 | 0.38 |
| LP2 | 64 | 7.77 | 0.58 | 63 | 6.76 | 0.44 |
| LM1 | 66 | 10.09 | 0.53 | 65 | 10.54 | 0.53 |
| LM2 | 84 | 9.65 | 0.53 | 79 | 10.29 | 0.56 |
| LM3 | 60 | 9.27 | 0.74 | 60 | 9.84 | 0.82 |

**Males**

| | BL | | | MD | | |
|---|---|---|---|---|---|---|
| **Tooth** | **N** | **x** | **s** | **N** | **x** | **s** |
| UI1 | 41 | 7.12 | 0.53 | 41 | 8.30 | 0.59 |
| UI2 | 46 | 6.27 | 0.47 | 47 | 6.39 | 0.60 |
| UC | 59 | 8.48 | 0.53 | 60 | 7.62 | 0.44 |
| UP1 | 59 | 8.93 | 0.67 | 59 | 6.77 | 0.40 |
| UP2 | 54 | 9.05 | 0.75 | 54 | 6.64 | 0.47 |
| UM1 | 59 | 11.38 | 0.50 | 60 | 10.10 | 0.49 |
| UM2 | 59 | 11.29 | 0.75 | 58 | 9.26 | 0.70 |
| UM3 | 31 | 11.04 | 1.00 | 33 | 8.80 | 0.89 |
| LI1 | 37 | 5.88 | 0.62 | 31 | 5.25 | 0.59 |
| LI2 | 46 | 6.26 | 0.41 | 44 | 5.68 | 0.40 |
| LC | 64 | 7.87 | 0.58 | 65 | 6.70 | 0.41 |
| LP1 | 66 | 7.52 | 0.55 | 66 | 6.68 | 0.41 |
| LP2 | 58 | 7.99 | 0.54 | 59 | 7.00 | 0.54 |
| LM1 | 60 | 10.39 | 0.42 | 58 | 11.09 | 0.53 |
| LM2 | 66 | 10.03 | 0.54 | 67 | 10.55 | 0.69 |
| LM3 | 69 | 9.76 | 0.59 | 67 | 10.64 | 0.66 |

N- number of teeth, x - average, s - standard deviation

**Table 5.31-3.** Penrose's distances between rural Metaponto and other populations. BL diameters only. Sexes combined (N=158).

| No | Population | Source | Sample size (N) | Penrose's*** | Test results |
|---|---|---|---|---|---|
| 1) | Minoans (Knossos), 1750-1550 BC | Carr (1960) | <100 ** | 0.0726 | **signif.** |
| 2) | Osteria dell'Osa (near Rome), 9-7 c. BC | Macchiarelli et al. (1995) | <100 ** | 0.0328 | not signif. |
| 3) | Sala Consilina (Salerno), 9-6 c. BC | Cucina & Coppa (1991) | 24 | 0.0803 | not signif. |
| 4) | **Urban Metaponto, 7-2 c.BC** | **own data** | 159 | 0.0592 | **signif.** |
| 5) | Alfedena (Abruzzo), 6-5 c. BC | Macchiarelli et al. (1995) | 108 * | 0.0258 | not signif. |
| 6) | Pontecagnano (near Naples), 7-4 c. BC | Mallegni et al. (1984) | 133 | 0.0117 | not signif. |
| 7) | Lucus Feroniae (near Rome), 2 c. AD | Manzi et al. (1997) | 51 | 0.0478 | not signif. |
| 8) | Portus Romae (near Rome), 2 c. AD | Manzi et al. (1997) | 64 | 0.0379 | not signif. |
| 9) | Romans (Israel), 1-2 c. AD | Tal & Smith (1981) | 61 | 0.2016 | **signif.** |
| 10) | Jews (Israel), 1-2 c. AD | Tal & Smith (1981) | 66 | 0.1328 | **signif.** |
| 11) | Silex Gallery (Spain), Neolithic-Bronze Age | Galera (1989) | 25 | 0.2235 | **signif.** |
| 12) | Vlasac (Yugoslav), 6300-5300 BC | y'Edynak (1989) | 42 | 0.4254 | **signif.** |
| 13) | Mehrgarh (Pakistan), 7000-2000 BC | Lukacs et al. (1985) | 57 | 0.2647 | **signif.** |
| 14) | Nubia (various sites), 3300-1100 BC | Calcagno (1989) | <100 ** | 0.2824 | **signif.** |
| 15) | Timargarha (Pakistan), 1400-850 BC | Lukacs (1983) | 80 | 0.0988 | **signif.** |
| 16) | Shanxi Shangma (China), 2700 BP | Inoue et al. (1997) | 566 | 0.1896 | **signif.** |
| 17) | Sarai Khola (Pakistan), 3 c. BC | Lukacs (1983) | 31 | 0.0810 | not signif. |
| 18) | Nubia (various sites), 0-1500 AD | Calcagno (1989) | <100 ** | 0.2004 | **signif.** |
| 18) | Mapungubwe & K2 (S.Africa), 1000-1300 AD | Steyn & Henneberg (1997) | 30 | 0.2133 | **signif.** |
| 19) | Medieval Sweden, 1060-1536 AD | Sagne (1976) | 124 | 0.0196 | not signif. |
| 20) | Ticuna (Colombia), modern | Harris & Nweeia (1980) | 30 | 0.3191 | **signif.** |
| 21) | Eskimo (Igloolik, Canada), modern | Mayhall (1979) | <100 ** | 0.1791 | **signif.** |

N - number of individuals in the sample
* - only maxillary dentition compared
** - number of individuals estimated from the number of teeth in each category
*** - Penrose's generalised distance

**Table 5.31-3A.** Penrose's distances between rural Metaponto and other populations. BL and MD diameters. Sexes combined (N=158).

| No | Population | Source | Sample size (N) | Penrose's*** | Test results |
|---|---|---|---|---|---|
| 1) | Minoans (Knossos), 1750-1550 BC | Carr (1960) | <100 ** | 0.1827 | **signif.** |
| 2) | Osteria dell'Osa (near Rome), 9-7 c. BC | Macchiarelli et al. (1995) | <100 ** | 0.1994 | **signif.** |
| 3) | Sala Consilina (Salerno), 9-6 c. BC | Cucina & Coppa (1991) | 24 | 0.1386 | **signif.** |
| 4) | **Urban Metaponto, 7-2 c.BC** | **own data** | 159 | 0.0486 | not signif. |
| 5) | Alfedena (Abruzzo), 6-5 c. BC | Macchiarelli et al. (1995) | 108 * | 0.0520 | not signif. |
| 6) | Pontecagnano (near Naples), 7-4 c. BC | Mallegni et al. (1984) | 133 | 0.0259 | not signif. |
| 7) | Lucus Feroniae (near Rome), 2 c. AD | Manzi et al. (1997) | 51 | 0.0307 | not signif. |
| 8) | Portus Romae (near Rome), 2 c. AD | Manzi et al. (1997) | 64 | 0.0992 | **signif.** |
| 9) | Romans (Israel), 1-2 c. AD | Tal & Smith (1981) | 61 | 0.3812 | **signif.** |
| 10) | Jews (Israel), 1-2 c. AD | Tal & Smith (1981) | 66 | 0.1556 | **signif.** |
| 11) | Silex Gallery (Spain), Neolithic-Bronze Age | Galera (1989) | 25 | 0.2998 | **signif.** |
| 12) | Vlasac (Yugoslav), 6300-5300 BC | y'Edynak (1989) | 42 | 0.5224 | **signif.** |
| 13) | Mehrgarh (Pakistan), 7000-2000 BC | Lukacs et al. (1985) | 57 | 0.1488 | **signif.** |
| 14) | Nubia (various sites), 3300-1100 BC | Calcagno (1989) | <100 ** | 0.206 | **signif.** |
| 15) | Timargarha (Pakistan), 1400-850 BC | Lukacs (1983) | 80 | 0.1044 | **signif.** |
| 16) | Shanxi Shangma (China), 2700 BP | Inoue et al. (1997) | 566 | 0.1499 | **signif.** |
| 17) | Sarai Khola (Pakistan), 3 c. BC | Lukacs (1983) | 31 | 0.0913 | not signif. |
| 18) | Nubia (various sites), 0-1500 AD | Calcagno (1989) | <100 ** | 0.1437 | **signif.** |
| 18) | Mapungubwe & K2 (S.Africa), 1000-1300 AD | Steyn & Henneberg (1997) | 30 | 0.4205 | **signif.** |
| 19) | Medieval Sweden, 1060-1536 AD | Sagne (1976) | 124 | 0.0703 | **signif.** |
| 20) | Ticuna (Colombia), modern | Harris & Nweeia (1980) | 30 | 0.4202 | **signif.** |
| 21) | Eskimo (Igloolik, Canada), modern | Mayhall (1979) | <100 ** | 0.2289 | **signif.** |

N - number of individuals in the sample
* - only maxillary dentition compared
** - number of individuals estimated from the number of teeth in each category
*** - Penrose's generalised distance

**Table 5.31-4**. Penrose's distances between rural Metaponto and other populations. BL diameters only. Females (N = 103).

| No | **Population** | Source | Sample size (N) | **Penrose's ****** | Test results |
|---|---|---|---|---|---|
| 1) | Lucus Feroniae (near Rome), 2 c. AD | Manzi et al. (1997) | 51 | 0.1201 | **signif.** |
| 2) | Portus Romae (near Rome), 2 c. AD | Manzi et al. (1997) | 22 | 0.1199 | not signif. |
| 3) | **Urban Metaponto (7-2 c.BC)** | **own data** | 87 | 0.0982 | **signif.** |
| 4) | Urban Metaponto (7-2 c. BC)# | " | 87 | 0.1416# | **signif.** |
| 5) | Urban Metaponto (7-2 c. BC)## | " | 87 | 0.0736## | not signif. |
| 6) | Pontecagnano (near Naples), 7-4 c. BC* | Mallegni et al. (1985) | 58 | 0.0306 | not signif. |
| 7) | Alfedena (Abruzzo), 6-5 c. BC ** | Coppa & Macchiarelli (1982) | 37 | 0.1276 | not signif. |
| 8) | Shanxi Shangma (China), 2700 BP | Inoue et al. (1997) | 266*** | 0.182 | **signif.** |
| 9) | Vlasac (Yugoslav), 6300-5300 BC | y'Edynak (1989) | 12 | 0.5769 | **signif.** |
| 10) | Medieval Sweden, 1060-1536 AD | Sagne (1976) | 34 | 0.1123 | **signif.** |

N - number of individuals in the sample
* - dentition from only the right side compared
** - only maxillary dentition compared
*** - estimated number of individuals from average number of teeth in each category
**** - Penrose's generalised distance
**# - rural Metaponto data are for burials dated to 7th-5th c. BC only (N = 57)**
**## - rural Metaponto data are for burials dated to 4th-3rd c. BC only (N = 45)**