The Linear Growth of Long Bones in Late Woodland Indian Children

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Abstract

Studies of the linear growth of long bones in children have almost exclusively utilized indirect measurements of the living plotted against chronological age. Such studies are only in a very general way applicable to age determination in archaeological populations. The present study is based on direct measurements of Late Woodland Indian Children and physiological age based on the degree of the development of the dentition. By plotting the lengths of individual long bones against dental age, group growth curves were constructed which allow the investigator to determine the dental age of an individual when adequate dentition is not present by measurement of the long bone alone. To discern the applicability of growth curves for a specific prehistoric American Indian population to other similar populations a comparative study of a Middle Mississippian group was undertaken. Although the results of this comparison were inconclusive, it seems prudent to apply the growth curves for the Late Woodland population studied only to very similar populations until more extensive comparisons can be made.

Studies of the linear growth of long bones in children have almost exclusively been limited to indirect measurements of the living taken from radiographs. Such studies introduce elements of distortion because of individual variability of the soft tissues and cannot be considered as parallel to direct measurements of dried bones (2). Usually the ages recorded for children in such studies are chronological rather than physiological. That is, they reflect the number of years since birth and not physiological maturity. In populations obtained from archaeological excavations only direct measurements of long bones can be made. It is also obvious that only the physiological age of the individual as indicated by dental and skeletal maturity can be obtained. Because of these discrepancies, age growth curves based on indirect measurements of the living are only in a very general way applicable to age determination from direct measurements of the skeletal remains of archaeological populations.

To avoid the error of applying growth curves based on indirect measurement and chronological age to skeletal populations, it seems reasonable to construct a group growth curve based on direct measurement of long bones and physiological age based on the degree of development of the teeth. Group growth studies of this type have previously been done by King B. Hunter for the Hopewellian population of the Klunk mound group in Calhoun County, Illinois. The present study follows Hunter's basic procedures.

The use of dental development as an age determinant is based on several factors. Teeth are consistently well preserved in archaeological populations and offer a rather complete record of growth. Secondly, the rate of development of the dentition is much less subject to variation due to extraneous environmental factors than is long bone growth.

Under conditions of dietary and hormonal stress the teeth seem to have priority for the use of deficient materials (1). For this reason teeth develop at a rather constant rate even in diverse populations. This is in sharp contrast to the rate of growth of long bones which varies significantly between populations. These growth factors allow the application of standard chronologies for tooth development to archaeological populations of unknown nutritional and physical makeup with a high degree of accuracy. In growth studies of skeletal populations therefore, the dental age of the individual can be treated as a relative constant against which the much greater variability of long bone growth can be plotted.

Charts which plot dental age against long bone length of a population are of great value because they allow the investigator to determine the approximate dental age of a child by direct measurement of long bones alone. Such charts are of particular value when dealing with an archaeological population because demographic studies can be made which include individuals who do not have adequate dentition for the assessment of dental age but do have intact long bones. Because of the increased sample size obtained from such assessments the validity of conclusions based on resultant mortality statistics is increased.

The skeletal material used in the present study was excavated by Gregory Perino during the summers of 1967 and 1968 from the Yokem mound group in Pike County, Illinois. The Yokem mound group consists of ten mounds which represent two distinct occupations of the area. Five of the mounds contained a bluff culture artifact assemblage and represent a relatively early Late Woodland occupation of the area. The remaining mounds represent a late occupation of the area by another group of Late Woodland peoples. Burial practices and artifacts from these later mounds indicate that this group was assimilating Middle Mississippian patterns. This assumption is corroborated by a relatively late radiocarbon date of A.D. 1208± 90 years.

The date for this study was obtained from children of the later population of Late Woodland peoples to use the Yokem mounds. These were individuals excavated from mounds 11-Pk°167, 11-Pk°168, 11-Pk°169, 11-Pk°170, and 11-Pk°171. Forty-three children were examined ranging in age from zero months to 12 years. Twenty-three additional children were excluded from the sample, either because adequate dentition and measurable long bones were missing or because marked dental pathologies were present which would obscure developmental patterns.

The dental age for each individual was assessed in terms of five stages of dental development. These stages are: first evidence of calcification, crown completion, eruption, root completion, and root reabsorption. All measurements of long bones were made exclusive of epiphyses.

Figures 1, 2, and 3 represent the relationship between the long bone lengths and the dental ages of the Late Woodland population of the Yokem mounds. The dots on the graph signify the dental age plotted against long bone length for specific individuals. The solid lines repre-

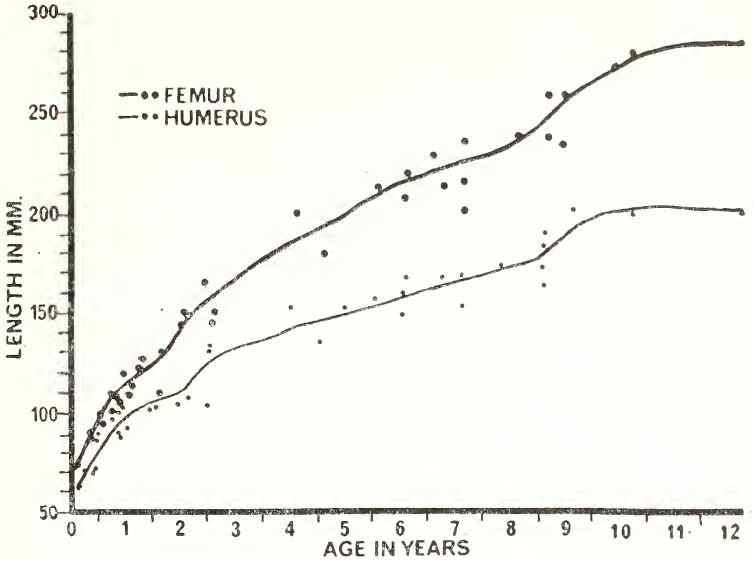

Figure 1. Length of humerus and femur plotted against dental age. Dots represent individual values, lines represent group growth curves.

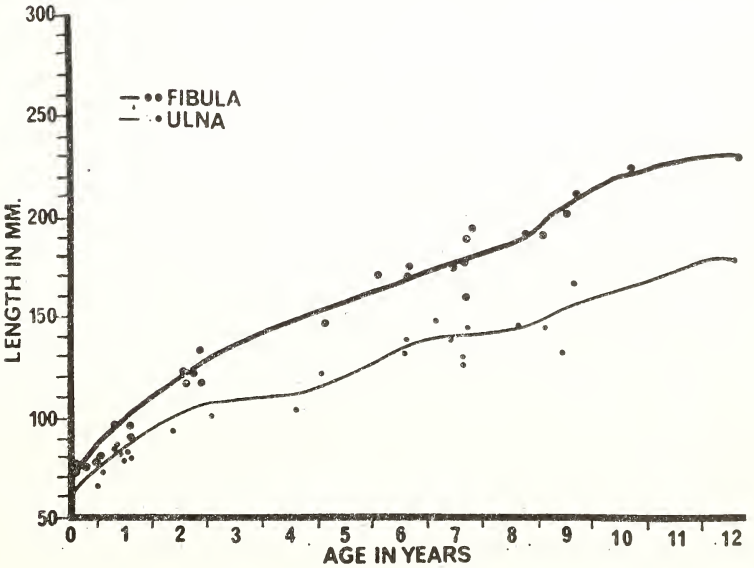

Figure 2. Length of fibula and ulna plotted against dental age. Dots represent individual values, lines represent growth curves.

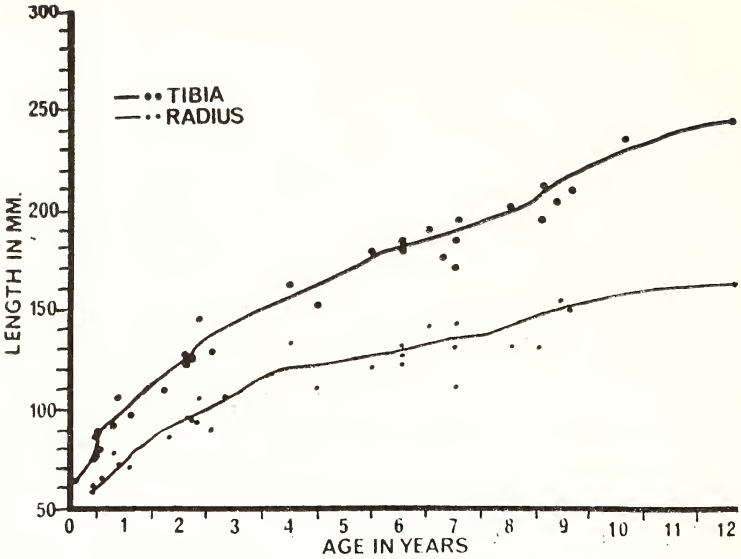

Figure 3. Length of tibia and radius plotted against dental age. Dots represent individual values, lines represent group growth curves.

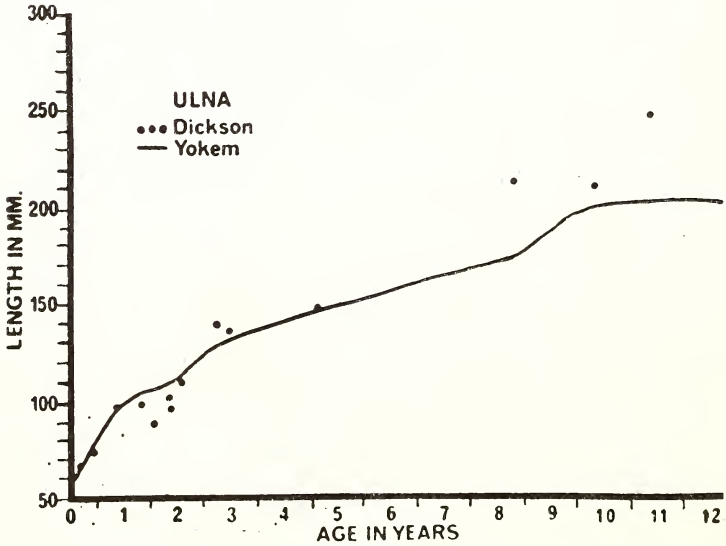

Figure 4. Lengths of ulnae from Dickson and Yokem mounds. Dots represent individuals from Dickson mound, line represents group growth curve from Yokem mounds.

sent the smoothed curve formed by these values. When these curves are examined it will be noted that at the age of about two and one-half years the rate of growth consistently decreases for all long bones. This decrease in rate of growth represents the end of the rapid growth of infancy. The next marked change in the growth rate takes place at about nine years of age where growth accelerates. This change in rate represents the hormonal initiation of growth in females of the population. It should be mentioned that no sexual identification was attempted for the children used in this study for two reasons. First the number of individuals of the ages during which differential growth rates because of sexual differentiation is too small to produce a valid sexual separation. Second, sexual identification of the skeletal remains of children is often unreliable, particularly when the ilium is not present to permit the measurement of the greater sciatic notch. Because sexual identification was not made, the female growth spurt which occurs at about nine years will be partially obscured by the unchanging male growth rate. At this point it should be emphasized that the growth curves illustrated in Figures 1, 2, and 3 do not indicate the growth rate of the average or normal individual, but illustrate the growth of the population as a group (2), regardless of sex.

To show the degree to which the growth charts constructed for the Yokem mound Late Woodland population can be applied to other prehistoric American Indian populations, a Middle Mississippian population was examined and data comparable to that from Yokem mounds was obtained. The individuals used in this comparative study were taken from burials excavated at Dickson Mounds (11-F°-34) in Fulton County, Illinois, during the summers of 1966 and 1967. This sample excluded the Late Woodland component of this site. Figure 4 represents by dots the dental age plotted against the ulna length of 14 children from Dickson Mound. There is no significant deviation in the growth rates of the two populations during early childhood. In later years, especially during the period of adolescent growth acceleration in females, the comparative sample shows consistently larger long bone lengths. There are several possible explanations for this deviation. Because of the small size of the comparative sample, sampling errors could easily account for this deviation. An alternative explanation could be that the two populations were nutritionally and/or physically different, and it is these differences that are reflected in Figure 4. Until larger comparative studies can be done, the growth rates of the Late Woodland population which is the subject of this study should be considered as strictly applicable only to populations which are archaeologically and physically very similar to the Yokem Mound population.

Literature Cited

1. JENKINS, G. NEIL. 1954. The physiology of the mouth. Blackwell Scientific Publications 183.

2. MARSH, M. M. 1955. Linear growth of long bones of extremities from infancy through adolescence. J. Dis. Child. 89:725-742.