THE PEOPLE OF THE BALL SITE

Jerry Melbye

ABSTRACT

The biological status of the first six burials from the Ball Site, a Late Ontario Iroquois site, are summarized. While ossuaries have produced large samples, these are largely disarticulated "populations of bones" rather than populations of people. The presence of relatively complete and articulated skeletons is important for setting and testing standards for ossuary studies. The data are presented as completely as possible because the skeletons have been reburied according to the agreement with the local native band council. The bases of determining age, sex, stature, bone pathology, dental status, dental attrition, caries, periodontal infection and abscessing are presented for each burial. Metrical and morphological observations of adults are presented and discussed. A new case of spinal tuberculosis is tentatively diagnosed. Relatively new methods of age determination of subadults by diaphyseal length and of adults by dental attrition are attempted. These latter two methods are probably "population specific" to the Ontario Iroquois.

INTRODUCTION

The Ball Site is a village of the Northern Division of the Late Ontario Iroquois Stage (Wright 1966). It is a particularly interesting village because it is large (9-10 acres) and it appears to have been occupied for a brief period (there are no overlapping or modified houses). The site is located about 1.5 km south of the famous Cahiague site, and appears to have been occupied ca. AD 1590 — 1600 (Knight and Snyder 1981), immediately prior to Champlain's visit to Cahiague in AD 1615. Knight began excavations in 1975 and, up to the 1982 field season, only six burials have been found. The burials are probably (Burial #2 is uncertain) all from under house floors (Knight and Melbye 1983). This paper is a statement on the biological status of these six individuals.

BURIAL 1

This is a child (8±1 year) of indeterminate sex. Previously, this burial has been reported by Kapches (1976:33) who aged the child at about six years. The skeleton is relatively complete and in fair condition.

Age Determination

Using the Schour and Massler (1944) standards of dental eruption, the mandible is between age 8 and 9. This conclusion is based primarily (but not exclusively) on the eruption of the second, permanent, mandibular incisor. Another method by Moorees, Fanning and Hunt (1963a, 1963b) is based exclusively on the calcification of crown and root of each tooth. Using this method, the child is age 8 (if male) or 7.5 (if female). However, due to lack of x-rays this is based exclusively on calcification of the first and second, permanent, maxillary incisors.

Melbye, Jerry
1983 The People of the Ball Site. *Ontario Archaeology 40:* 15-36.

Yet another technique is the Merchant and Ubelaker (1977) method which essentially plots diaphyseal length of long bones against dental age for protohistoric Arikara. They conclude that their method works best when the Moorees, Fanning and Hunt (1963a, 1963b) dental standards are used. In the absence of any comparable study for Iroquois populations, the Arikara standards are suitably close in time (both are protohistoric) and in subsistence (both are corn agriculturalists). Admittedly, genetic differences are inevitable, and standard deviations are impossible to calculate. Nevertheless, the results are intriguing (Table 1). This child consistently ages between 6.8 and 7.3 years with an average of 7.0 years.

Obviously, considering the three methods together, an overall age at death estimate of 8 years (±1 year) is sufficiently close to satisfy all the methods.

TABLE 1

DIAPHYSEAL MEASUREMENTS (MM) OF BURIAL 1 COMPARED WITH THE MOOREES, FANNING AND HUNT CURVE IN MERCHANT AND UBELAKER (1977).
(estimated measures are in parentheses)

Bone	Right	Left	Best Est.	Age
Clavicle	—	(102)	102	n.a.
Humerus	(193)	191	192	7.0
Radius	—	—	—	—
Ulna	—	—	—	—
Femur	(262)	265	265	7.1
Tibia	218	218	218	6.8
Fibula	217	213	215	6.8
Ilium	—	101	101	7.3

Sex Determination

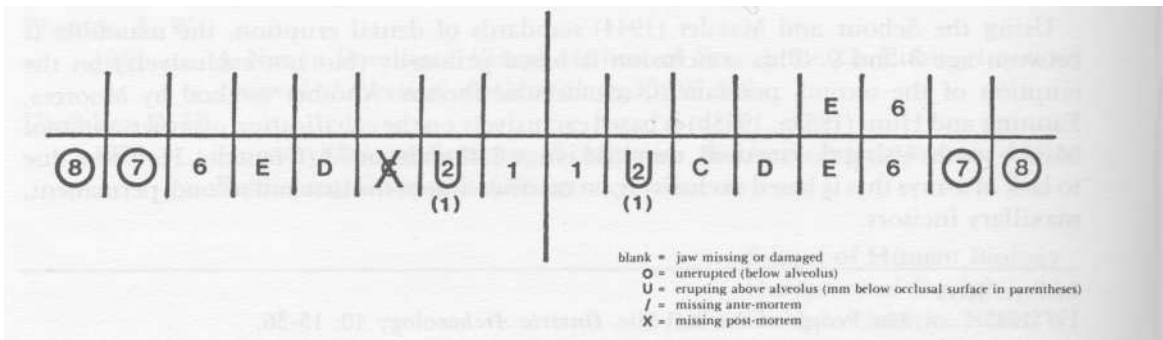
No attempt was made to estimate the sex of this child because of its immature age.

Bone Pathology

The entire skeleton is pathology free.

Dental Status

There are 19 loose teeth, and the jaws contain a mixed dentition of deciduous and permanent teeth. The eruption status follows (notation after Palmer 1891):



Dental Attrition

The first permanent molars are already showing wear facets on the cusps even though they have only been in the mouth about two years. The enamel of the first and second deciduous molars has worn smooth, but this wear is typically irregular and is not categorized here.

Caries

The first deciduous maxillary molars both have caries. The left molar has the largest caries — involving about a third of the crown on the buccal side. Small pit caries are beginning to be established in the buccal pits of the first, permanent, mandibular molars; the second, left, deciduous, mandibular molar; and the second, left, deciduous, maxillary molar.

Periodontal Infection

None are present on the remains.

Abscesses

None are present. However, the socket (if it were present) for the first deciduous maxillary molar should have some evidence of abscessing. The large caries (described above) involves most of the pulp chamber.

BURIAL 2

This appears to be a middle age (46±4 years) male. The skeleton is relatively complete and in fair condition.

Age Determination

Dentition could not be used for age determination. There are only four loose maxillary teeth which are not absolutely identifiable because of advanced dental attrition.

Public symphyses usually provide moderately accurate estimations of adult age. Conclusions based on morphology of public symphysis are somewhat tentative because of damage to the dorsal rim.

McKern and Stewart (1957) models:

Component I = 4 or 5
Component II = 4 or 5
Component III = 3, 4, or 5
total, min. = 11 = age 23-39
total, max. = 15 = age 36+

Todd (1920) method: Stage 8
= age 45 50

Ectocranial suture closure (Montagu 1960) is widely known to be unreliable. Nevertheless, the method was used in an attempt to find some confirmation. The critical suture appears to be the occipital suture with an estimated age between 42 and 47 years.

Overall consideration places most reliability on the Todd method because the damaged area obscures the McKern and Stewart results. Further, McKern and Stewart results are not clear on individuals over age 28. Finally, ectocranial suture closure tends to corroborate the results from the Todd method. Therefore, I have chosen age 46±4 to span the results of these latter two methods.

Sex Determination

The skull is large with pronounced brow ridges, mastoid processes, and muscle markings indicating a male. The ilium is high rather than flared out and the preauricular sulcus is shallow indicating a male. The greater sciatic notch is wide indicating a female. The absence of the ventral arc of the pubis (Phenice 1969) indicates a male. It is clear that one can only conclude that Burial 2 is a male.

Stature

The formula for Mongoloids in Trotter and Gleser (1958:120) provides the best estimate:

1.22 (Fem. + Tib) + 71.75±3.68
1.22 (46.6 + 38.2) + 71.75 = 175.2±3.68 cm
175.2 cm = 69.0 inches = 5 ft. 9 inches

Bone Pathology

Generally, there is a moderate amount of arthritis on the joints and osteophytosis on the vertebral bodies. However, the left, superior and inferior articular facets of C3, C4, and C5 are heavily pitted and lipped. The fact that this condition is unilateral and localized suggests traumatic arthritis as a result of some unspecified trauma to the left side of the neck (from a right handed person?).

Dental Status and Dental Attrition

Four teeth are present. A permanent, maxillary, right, third molar has Stage F dental attrition (flat enamel). A permanent, maxillary unsided, second premolar has dental attrition well into the dentin. Two permanent, maxillary (?), unsided, unspecified incisors have only functional roots.

Caries

None present on four teeth. This is probably because of advanced dental attrition.

Periodontal Infection

No observations are possible.

Abscesses

A large abscess is present on the left, anterior part of the palate. The abscess extends into the nasal cavity. It is impossible to determine which tooth was the origin of the abscess.

BURIAL 3

This is a child (11±1 year) of indeterminate sex. The skeleton is very nearly complete, and the bones are in excellent condition. There is no evidence of ante-mortem or post-mortem damage. The child probably died of an almost "textbook case" of spinal tuberculosis.

Age Determination

The dental development is inconsistent with standard charts. Ubelaker (1978:47-48) is used as the best composite description of Amerindian dental development. A complete set of 32 permanent teeth is present. However, the following teeth have not reached the occlusal surface: the third, permanent molars have not begun to erupt (age 15); the upper, second, permanent molars have almost (4 mm short) completed eruption (ca. age 12); and the second, permanent premolars are in the process of erupting (ca. age 11). The best age, considering the dental eruption as a whole, is about 11.5(±1) years.

Using the method of Merchant and Ubelaker (1977) and following their derived growth curves correlated to the dental standards of Moorees, Fanning and Hunt (1963a, 1963b), the following data are generated (maximum length of clavicle has been added for future comparative studies since they are so commonly complete):

TABLE 2

DIAPHYSEAL MEASUREMENTS (MM) OF BURIAL 3 COMPARED WITH THE MOOREES, FANNING AND HUNT CURVE IN MERCHANT AND UBELAKER (1977).

Bone	Right	Left	Best Est.	Age
Clavicle		114	114	n.a.
Humerus	232	230	231	10.2
Radius	186	185	186	10.2
Ulna	202	203	203	10.2
Femur	327		327	10.3
Tibia	279		279	10.4
Fibula	269	270	270	10.3
Ilium	102	102	102	7.3

Table 2 strongly indicates that this child is slightly above age 10. In this case it is wise to overlook the ilium measurement because the hip region is involved with tuberculosis pathology. Again, it is impossible to know how accurate this method is, but one must be impressed with the internal consistency of the results.

All long bone and short bone epiphyses are completely open. Epiphyseal closure, therefore, could not be used to estimate age.

Finally, an overall age estimation must give more weight to the dentition. Dental development is generally more accurate than skeletal development, and the full effect of tuberculosis on skeletal growth is an unknown factor. For these reasons, then, the child is estimated to be age 11±1 year.

Sex Determination

No attempt was made to estimate the sex of this child because of its immature age.

Bone Pathology

The entire skeleton is pathology free save the spinal column from the third thoracic vertebra to the end of the sacrum, the two hip bones, and the proximal ends of the femora. These bones show a great deal of pitting with a fine "bubbly" surface so characteristic of infection (for similar lesions see Katzenberg 1977).

On the vertebrae the bodies are exclusively involved (not the posterior arches). There are four rather larger lesions which show the foci of the infection (Fig. 1): between the sixth and seventh thoracic vertebrae, between the twelfth thoracic and first lumbar vertebrae, the second lumbar vertebra, and the first segment of sacrum. The infection has affected the hip bone and proximal femur on the left side more strongly than the right. There is no evidence of new bone formation on any of the bones.

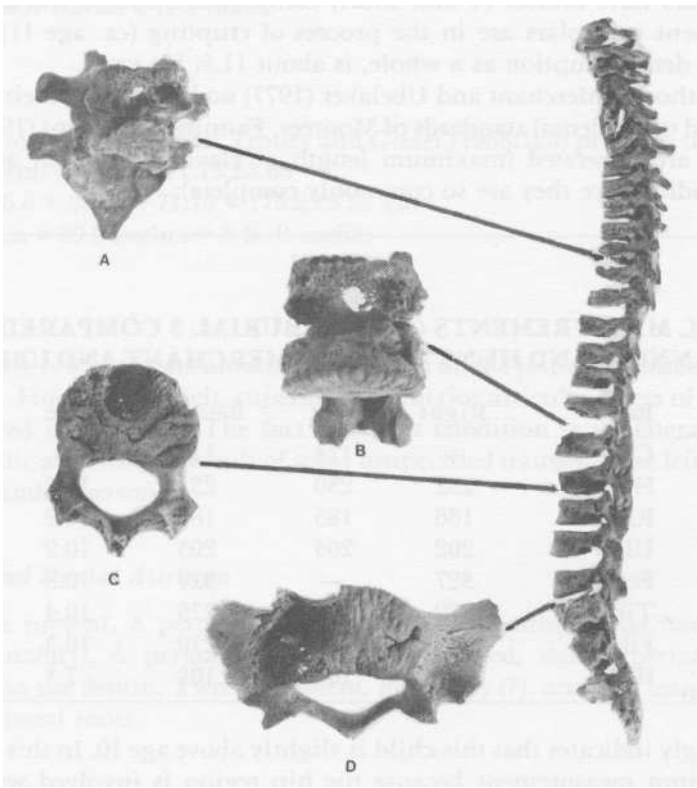


Fig. 1. Burial 3 is an 11(±1) year old child with vertebral lesions (probably spinal tuberculosis). There are four foci of infection: (A) between T6 and T7, (B) between T12 and L1, (C) the inferior surface of L2 and (D) the superior surface of S1.

Steinbock (1976) notes from a secondary source (Whitman 1927) that *87%* of skeletal tuberculosis occurs in patients who are less than age 14. He (Steinbock *1976)* further notes that the most frequent site for skeletal tuberculosis is in the spinal column; the hip and knee joint are the next most frequent sites. Two or more foci of tubercular involvement are uncommon, but researchers differ in their definition of focus of infection. If focus of infection means the largest site, then it is not surprising that most people report a single focus. The largest focus of infection in this child is the one between the twelfth thoracic and first lumbar vertebrae.

"The gross appearance of spinal tuberculosis may vary considerably depending on the virulence of the organism and the resistance of the host to the infection. Thus, there may be marked bone destruction with little new bone formation or a chronic infection with bone regeneration. The central and anterior portions of the vertebral bodies are the most common sites of tubercular destruction. The infection reaches the center of the vertebral body through the venous plexus and the anterior portions often become involved by extension of a paravertebral abscess to the bone. In the latter case, three or more adjacent vertebrae are often affected. Tuberculous infection rarely involves the transverse process, pedicles, lamina, or spinous process of the vertebrae" (Steinbock 1976:179).

Other possible diagnoses for this pathology include pyogenic osteomylitis, and septic arthritis (Morse 1961; Ortner and Putschar 1981; Buikstra 1981). However, none of these forms of pathology match the skeleton and the foregoing description of spinal tuberculosis so closely, and spinal tuberculosis must be the most likely disease which caused the death of this child. It should be noted that tuberculosis is not rare in Ontario (Hartney 1981).

A new observation which has been previously unreported in the diagnosis of tuberculosis is the apparent retardation of growth of the hip bones. Table 2 clearly shows that the ilium is disproportionately small when compared to other limb measurements. The direct involvement of the hip as a focus of infection strongly suggests the cause for this apparent dysplasia.

Dental Status

Dental eruption has already been discussed under the Age Determination subheading. For a variety of reasons this child is assumed to be about age 11.

Dental Attrition

Because of the age of this child, dental attrition is only slight to absent. All four first permanent molars have slightly blunted cusps which represents about five years of wear. The central incisors are worn to the beginning of the dentin which represents about four years of wear. The lateral incisors are only slightly blunted which represents three years of wear. No other teeth show dental attrition.

Caries

A small caries is present in the buccal groove of each of the mandibular first molars which represents about five years of exposure. The only deciduous teeth present, the upper second premolars, have large caries involving the entire mesial half of the crowns. This latter case represents only nine years of exposure in the mouth.

Periodontal Infection

None has begun to form.

Abscesses

None are present; however, X-ray films were not used to confirm this.

BURIAL 4

This individual is a young adult female (age 24±3 years). She is quite short (5 feet 2 inches) by Iroquoian standards (Anderson 1964). The skeleton is not complete, but what is present is in excellent condition. Outstanding amongst the missing parts within the grave is the skull (the jaw is present). There has been post-mortem damage due to partial burning which was probably part of the mortuary practice. There is moderate evidence of dental caries, dental attrition, and periodontal infection. The only bone pathology involves the lower back which probably was a general infection of the vertebral bodies (osteomyelitis) which further resulted in bony growths (osteophytosis) around the vertebral bodies. It remains speculative whether this infection caused death.

Age Determination

In the absence of the pubis and the skull, there remains very little evidence regarding the age at death. An effort was made to estimate the age at death from dental attrition. It was noted that the first molars of Burial 3 have blunted cusps which are very similar to the third molars of Burial 4. If those blunted cusps represent about five years wear in Burial 3, and if the third molars of Burial 4 erupted at age 18, and if we estimate the same number of years of wear for those third molars, Burial 4 is estimated to be about age 23. However, the eruption of third molars is highly unpredictable.

Another way to make a guess is to examine the second molars of Burial 4. It is highly probable that they erupted at age 12. Also, they show roughly twice the amount of dental attrition as those first molars on Burial 3. If twice the amount of dental attrition is roughly equal to twice the number of years of wear, we can estimate that the second molars of Burial 4 have been in the mouth for about 10 years. This gives another estimate of age at death of 22.

In general, it is felt that these estimates are slightly conservative. It should be obvious that there is not a constant rate of wear between stages of dental attrition. Initially, wear is slowed down because increasing amounts of enamel are encountered. It is probable, therefore, that this individual is older than 22. On the basis of these rather tenuous observations I would guess that this woman died at about age 24 (±3 years).

Sex Determination

Again, the critical parts are missing. The best area, the pelvic girdle, is too fragmentary to be useful for sex estimation. The second best area, the skull, is missing. The mandible, however, is present, and it has slight muscle markings and a slightly obtuse mandibular angle. The third best area, the long bones, is all that remains. In general, the bones are slender and not well muscle-marked. This observation suggests a higher probability that the individual is female. Additionally, measurements of three articular surfaces are used (Table 3). These measurements have a bimodal distribution in other Iroquoian populations which is associated with sex (Anderson 1964:34-39):

TABLE 3

COMPARISON OF BURIAL 4 WITH FAIRTY SITE DISTRIBUTION

	Burial 4(mm)	Fairty
Maximum Head Diameter of Femur	38	smallest of 155 measurements
Maximum Head Diameter of Humerus	37	5 of 143(3%) are same or less
Minimum Head Diameter of Humerus	35	2 of 124(2%) are same or less

While this method of sex determination is undesirable because of the large overlap of males and females in the middle of the distribution, in this particular case (Burial 4) the conclusion is clear. There is almost no chance for overlap at the extreme ends of the distribution, and the conclusion is overwhelming that this individual is female.

Stature

The formula presented in Trotter and Gleser (1958:120) is used:

1.22 (Fern + Fib) + 70.24 = Stature ±3.18 cm
1.22 (40.3 + 32.0) + 70.24 = 158.3 ±3.18 cm
158.3 cm = 62.3 inches = 5 ft. 2 inches

Bone Pathology

Pathology appears in the lumbar vertebrae and in the right tibia. The tibia has a slight infection (periostitis) on the anterior midshaft surface. The infection is undoubtedly due to a trauma to the shin area which has a slight swelling about one centimetre in diameter. The surface of the swelling has more intense "bubbling" which further indicates the focus of the infection. It was still infected at time of death — though it could not be responsible for death. The pieces of vertebrae are badly broken and burned which greatly hinders the description. The few cervical and thoracic vertebrae which are present are pathology free, even of arthritis. Indeed, the entire remains are free of arthritic lipping in the synovial joints. This is further confirmation of a very young adult age.

The lumbar vertebral bodies have the "bubbly" surface so characteristic of a generalized infection, probably osteomylitis. The rims of the vertebral bodies have heavy bony lipping, probably in response to the infection. It is possible that some damage was present on missing pieces which would have given some clue to the origin of the infection. It is unlikely that this person was suffering from tuberculosis, but it is possible. It is unlikely because new bone formation (osteophytosis) is uncommon in tuberculosis, and there are no large lesions into the vertebral bodies — at least not on the fragments which are present.

Dental Status

The mandible is intact and in good condition. A complete set of adult teeth is in this jaw save the third, left molar which has been lost ante-mortem. The socket for this tooth is in the process of resorption suggesting its loss within the year preceding death. Additionally, there are ten loose maxillary teeth. They are similar in colour and wear to the mandibular teeth; therefore, it is assumed that these teeth are from the missing skull. These maxillary teeth include: the right and left central incisors, the right lateral incisor, the four premolars, the right second molar, and the right and left third molars. These loose teeth are in excellent condition, but provide no clue to how they came to be missing from the skull.

Dental Attrition

The third molars have blunted cusps. The second molars have slightly more wear, but the grooves and cusps are all clearly visible. The first molars have moderate dental attrition with the grooves beginning to obliterate on the edges and the first small islands of dentin appearing through the cusps. Dentin is also clearly visible on the occlusal surfaces of the canines and incisors. There is slightly greater wear on the left side than the right side, perhaps due to pain from the infected third molar on the right side.

Caries

Of the teeth present, a large caries is present in the left, second, mandibular molar. About a third of the crown is missing from a large cavity which extends deep into the dentin. The

caries is on the buccal side of the crown suggesting a possible origin from the buccal pit or groove (note similarity to Burial 3). Other small pit caries occur on the occlusal surface of the third, left mandibular molar; the second, right, mandibular molar (including the buccal groove); the first, right and left, mandibular molars; the second, right and left, mandibular and maxillary premolars; and the third, right and left, maxillary molars. Finally, it is highly likely that the third, right, mandibular molar was lost due to caries into the pulp chamber. There is some evidence of infection in the healing crater left by the tooth.

Periodontal Infection

Some is apparent along the molars and premolars on the right side of the mandible. It is slight to moderate.

Abscesses

None are apparent from the external surface of the mandible — except the third molar which has already been discussed. However, this conclusion is suspect without an x-ray.

BURIAL 5

This individual is a 32 (±4) year old male (Fig. 2). The bones are in very good condition, and there is no evidence of burning or post-mortem alteration. The entire skeleton is pathology free except for moderate osteoarthritis on most of the joints.

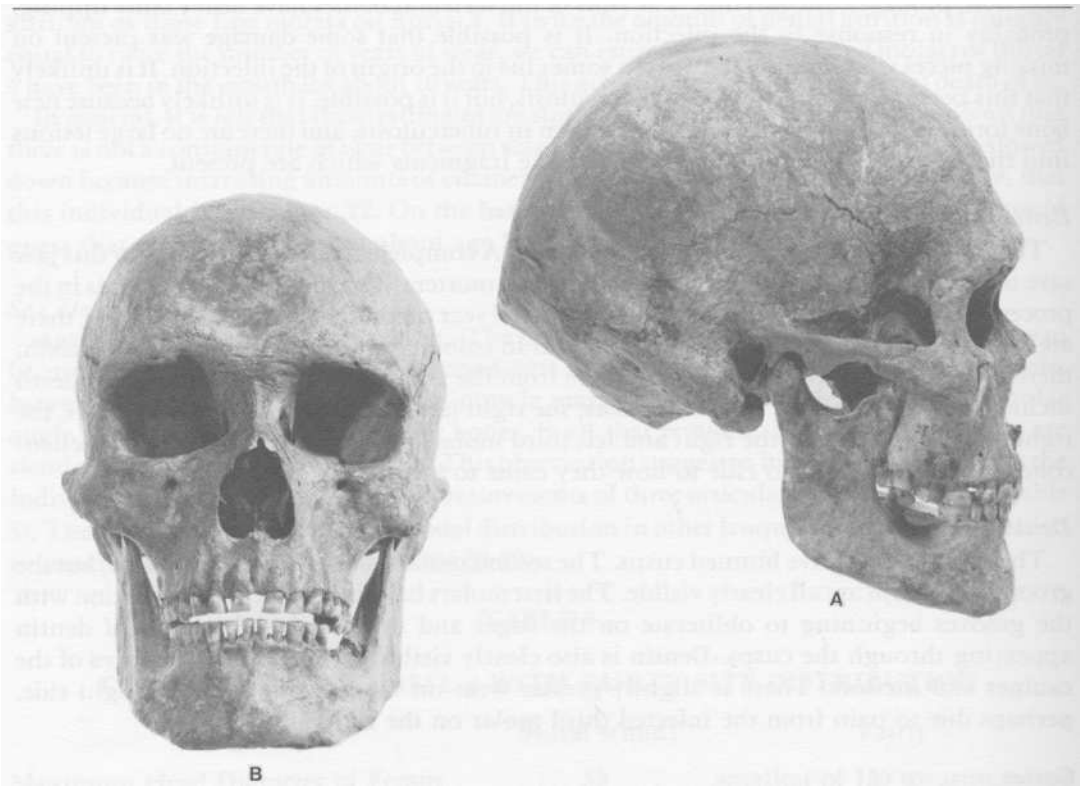


Fig. 2. Burial 5 is a 32(±4) year old male in a remarkably good state of preservation. (A) norma lateralis (right) and **(B)** norma frontalis.

Age Determination

The pubic symphyses are in excellent condition.

McKern and Stewart (1957) models:

Component I = 4
Component II = 2
Component III = 5

11 = age 23 - 39 (or 31±8)

Todd (1920) method:

Stage 6 = age 30-35 (or 32.5±2.5)

The cranium was inspected for ectocranial suture closure (Montagu 1960) only as a cross-check. The coronal suture provided the youngest maximum age of 38 years, and the lambdoidal suture provided the oldest minimum age of 26 years. The range of 26-38 (or 32±6) is quite compatible with the data from the pubic symphyses.

If we consider all the results acceptable and consider the range of each result, the mean is 31.6±4.27 (or simply 32±4 years).

Sex Determination

The hip bones were inspected for sciatic notch, muscle markings, subpubic angle, pre-auricular sulcus, and the three traits of Phenice (1969). All traits are clearly in the male range. The skull was inspected for brow ridges, muscle markings and mastoid process. Again all traits are well within the male range.

Stature

Again, the Trotter and Gleser (1958:120) formula seems to be the most appropriate:

1.22 (Fern + Tib) + 70.37 ±3.24
1.22 (49.5 + 42.3) + 70.37 = 182.4 ±3.24 cm
182.4 cm = 71.8 in. = 6 ft. 0 inches

Bone Pathology

Every bone was carefully inspected, and the skeleton appears to be free of pathology except for some moderate degenerative changes. Most joints show moderate lipping. No joint has severe arthritis or osteophytosis.

Dental Status

A complete set of 32 adult teeth were once present; however, the mandibular, left, first molar is missing ante-mortem.

Dental Attrition

The left side of the jaw has irregular dental attrition which is probably the result of the missing molar. However, the right side has a regular pattern. The first molar is reduced (nearly) to an enamel rim around a surface of dentin. The second molar has flattened enamel with the first island of dentin visible, and the third molar has flattened enamel with grooves present.

Caries

The teeth are free of caries.

Periodontal Infection

There is moderate periodontal infection along all the teeth.

Abscesses

None are present on the surface of the bone. It is probable that the missing molar was lost due to abscessing; however no lesion was present at time of death.

BURIAL 6

This burial is an infant, aged 8 (±1) months, of indeterminate sex. Surprisingly, most of the bones of the skeleton are present even though the burial had been badly disturbed. As might be expected, the bones are quite fragile and broken. There is no evidence of pathology.

Age Determination

Using the Schour and Massler (1944) standards of dental eruption, the infant ages at 9 (±3) months. This conclusion is based upon the deciduous, maxillary, left, first incisor which has erupted about 3 mm above the alveolus and the deciduous, mandibular, left, second incisor which has moved about 1 mm above the alveolus. No teeth, other than incisors, have begun to erupt.

The Merchant and Ubelaker (1977) method was also applied:

TABLE 4

DIAPHYSEAL MEASUREMENTS (MM) OF BURIAL 6 COMPARED WITH THE MOOREES, FANNING AND HUNT CURVE IN MERCHANT AND UBELAKER (1977).
(estimated measures are in parentheses)

Bone	Right	Left	Best Est.	Age
Clavicle	—	—	—	—
Humerus	(91)	—	(91)	0.5
Radius	(70)	—	(70)	0.6
Ulna	(80)	—	(80)	0.6
Femur	—	(105)	(105)	0.5
Tibia	-	-	-	-
Fibula	-	-	-	-
Ilium	(50)	53	53	0.7

Two things are important to note from Table 4. First, the overall average age is 0.58±0.08 year which is approximately 7 (±1) months. Secondly, the only measure which is not estimated is the ilium, and the calculated age of 0.7 years is approximately 8 months.

One is faced with three conclusions: the infant is either 7, 8 or 9 months old. The results are really very close, and an overall estimate of 8 (±1) months seems appropriate.

Sex Determination

No attempt was made to estimate the sex of this infant because of its age.

Bone Pathology

The remains are free of apparent pathology.

Dental Status

The deciduous, maxillary, right incisors are missing because of missing segment of jaw. The deciduous, mandibular, right incisors and canine are missing post-mortem. The deciduous mandibular, left, first incisor is also missing post-mortem. All other deciduous teeth are intact inside the alveolus.

Dental Attrition

There is no opportunity for dental attrition since none of the teeth are fully erupted. Similarly, there is no caries or periodontal infection.

DISCUSSION OF THE HUMAN OSTEOLOGY

The six burials at the Ball Site present us with a most outstanding picture of the people who occupied the site. The array of ages span the period from birth through middle aged adulthood, and we are presented with a young adult female and male (Table 5). This is quite a lot to ask from such a small sample. If one could select only six individuals to represent a population, I doubt that the selection would differ much from this series (an infant, a child, an adolescent and three adults aged in the 20's, 30's and 40's).

TABLE 5

SUMMARY OF THE BURIALS AT THE BALL SITE

Burial #	Age	Sex	Stature	Other
1	8±1	?	—	possible abscess
2	46±4	M	5'9"	traumatic arthritis, neck
3	11±1	?	—	spinal tuberculosis
4	24±3	F	5'2"	extremely short
5	32±4	M	6'0"	extremely tall
6	*8±1	?	—	—

* months

It appears that the Merchant and Ubelaker (1977:67-70) method for age determination of subadults works quite well on Iroquoian populations (see also Katzenberg and White 1979). The results have internal consistency and they seem to agree closely with other age determination methods. This is very important for future Iroquoian studies because of the presence of disarticulated skeletons in ossuaries. Diaphyses of long bones can be measured and subsequently aged with reasonable confidence.

The use of dental attrition to age individuals is by no means new (e.g. Miles 1963; Butler 1972; Nowell 1978). The method is of limited use because it is population specific. That is, the rate of dental attrition varies from one population to another and may vary for one population over time as diets change. These problems added to the spectre of internal population differences (due to status, sex, food preference, pathology, and genetic

variability in enamel hardness) has rendered the method unpopular. Nevertheless, the egalitarian society (Sykes 1983) and stable diet (Katzenberg 1983) of the Ontario Iroquois make them prime candidates for establishing age determination standards based on dental attrition. This has probably not been done because of ossuary burials and the resulting disarticulated skulls. One cannot establish precise ages for skulls with only suture closure for corroboration. Articulated skeletons are needed for initial establishment of standards of rates of dental attrition. These standards have begun here:

STAGES OF DENTAL ATTRITION

(The first three are for clarification of what is usually described as "0" attrition.)

Stage A = Unerupted, below the alveolus.
Stage B = erupting, above the alveolus but below the occlusal plane.

Stage C = erupted to the occlusal plane but no wear facets are apparent.

Stage D = wear facets clearly visible on the cusps.

Stage E = cusps worn flat but fissures between cusps *may* still be clearly visible.

Stage F = flat enamel with one to four islands of dentine exposed, but none of the islands are conjoined.
Stage G = conjoined islands of dentine present (some "islands" may not be exposed yet).

Stage H = dentine exposed over entire surface of tooth surrounded by a ring of enamel. An isolated fragment of surface enamel may be present.

Stage I = exposed pulp chamber and/or functional roots.

Using the foregoing stages and applying them to the Ball site burials (Table 6) is a tentative beginning at establishing age determination standards for people of the Ontario Iroquois Tradition (Wright 1966). Stage C is added to the table as an assumed fact which, of course, is a somewhat dangerous assumption. Stage D occurs by the next year if the age determination of Burial 1 is accurate. In other words, once a molar reaches the occlusal level, it will have blunted cusps by the next year. How long does Stage D last? The table only tells us that the transition from Stage D to Stage E occurs sometime after 5 years (see M3) and less than 11 years (see M2) from Stage C; or, more simply, the transition from Stage D to Stage E occurs about 8(±3) years after Stage C. Following these logical inferences Table 7 is derived which can be used for age determination on the basis of dental attrition. I am painfully aware of the limited data upon which the table is based. Nevertheless, I present it so that other investigators can add their data and refine (or refute) the method.

Finally, the metrical (Tables 8 and 9) and morphological data (Tables 10 and 11) are presented for future population studies.

In agreement with the local Band Council, these skeletons have been reburied, and are no longer available for further analysis. Samples of bony tissue were retained including a one centimetre section of femur midshaft (osteon age determination, etc.) and the ribs from one side (trace elements, etc.). Already, part of these samples have been used in a survey of stable carbon isotopes and nitrogen in prehistoric diets (Schwarcz, Katzenberg, Knyf and Melbye 1983). It is recommended that similar samples should be retained from all skeletons which are to be reburied.

TABLE 6

SUMMARY OF **DENTAL ATTRITION** ON **MOLARS FROM THE BALL SITE BURIALS**

Stage C is assumed and upper and lower molars are averaged. Age ranges are variable and must be considered; however, they are not presented in this figure for the sake of clarity. Only dental attrition on jaws which are relatively pathology free are considered.

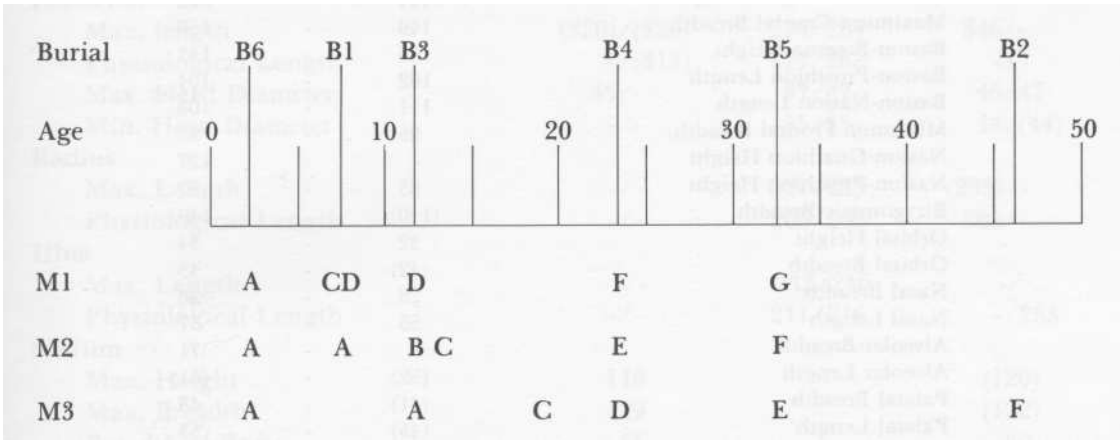


TABLE 7

CORRELATION OF STAGES OF DENTAL ATTRITION WITH CHRONOLOGICAL AGE BASED ON **LIMITED DATA (TABLE 6) FROM THE BALL SITE**

Ages are estimated from birthday to birthday. M3 is assumed to erupt during age 18. All molars are assumed to wear at an equal rate once they reach the occlusal level.

Stage	M1	M2	M3
A	6	12	18
B	6	12	18
C	7	13	19
D	8	14	20
E	15(±3)	21(±3)	27(±3)
F	22(±2)	28(±2)	34(±2)
G	33(±?)	39(±?)	45(±?)
H	?	?	?
I	?	?	?

Therefore a jaw with Stage E dental attrition on its second molar could tentatively be aged 21-28 years (a seven year spread) or, more conservatively, 18-30 (a twelve year spread).

TABLE 8

CRANIMETRICS OF THE ADULTS (IN MM) (estimated measures are in parentheses)

Measure	#2	4	#5
Maximum Cranial Length	191	-	202
Maximum Cranial Breadth	140		150
Basion-Bregma Height	146	-	143
Basion-Prosthion Length	102	-	104
Basion-Nasion Length	111	-	108
Minimum Frontal Breadth	95	-	93
Nasion-Gnathion Height			127
Nasion-Prosthion Height	65	-	77
Bizygomatic Breadth	(140)	-	149
Orbital Height	32	-	34
Orbital Breadth	(42)		45
Nasal Breadth	26		26
Nasal Length	55		57
Alveolar Breadth	-		71
Alveolar Length	(52)		(61)
Palatal Breadth	(41)		48
Palatal Length	(45)		53
Biasterionic Breadth	109		113
Bistephanic Breadth	111		
Bijugal Breadth	(118)		123
Ectoconchion Breadth	(102)	-	105
Simotic Chord	7		5
Bifrontal Chord	103		108
Nasio-Frontal Subtense	18	-	18
Bimaxillary Chord			112
Zygomaxillare Subtense			**33**
Nasion-Bregma Chord	114		122
Nasion-Bregma Subtense	22		28
Nasion-Subtense Fraction	57	-	70
Bregma-Lambda Chord	111		114
Bregma-Lambda Subtense	21		23
Bregma-Subtense Fraction	61		54
Lambda-Opisthion Chord	101		104
Lambda-Opisthion Subtense	31		38
Lambda-Subtense Fraction	53	-	45
Frontal Arc	126		139
Parietal Arc	121		125
Occipital Arc	124		128
Maximum Mandibular Length	120	101	121
Mandibular Body Length	90	77	87
Bicondylar Breadth	(131)	111	(130)
Minimum Ramus Breadth	39	34	32
Ramus Height	57	45	70
Bigonial Breadth		(86)	109
Coronoid Height	66	54	69
Symphysis Height		29	39
Mandibular angle	120	123	120

TABLE 9

INFRACRANIAL METRICS (MM) OF THE ADULTS LEFT/RIGHT (estimated measures are in parentheses)

Measure	#2	#4	#5
Clavicle			
Max. Length	-/-	138/-	-/(178)
Humerus			
Max. length	(320)/(320)	278/284	346/-
Physiological Length	-/(313)	274/282	-/-
Max. Head Diameter	43/-	37/37	46/47
Min. Head Diameter	-/-	35/35	44/(44)
Radius			
Max. Length	-/-	221/225	(283)/
Physiological Length	-/-	206/209	265/-
Ulna			
Max. Length	-/-	242/246	-/-
Physiological Length	-/-	211 /216	-/263
Sacrum			
Max. Height	116		(120)
Max. Breadth	129		(122)
Breadth of Body	65		60
Pelvis			
Max. Diameter	298	-	
Inlet (Sagittal)	115		124
Inlet (Transverse)	137		
Innominate			
Height	-/227	-/-	242/-
Acetabulum - Pubis	90/-	-/-	-/91
Acetabulum - Ischium	(85)/87	-/-	92/88
Femur			
Max. Length	466/-	402/-	-/(495)
Physiological Length	462/-	395/-	-/-
Platymeric, Sagittal	26/25	20/-	24/25
Platymeric, Transverse	36/37	28/-	35/36
Max. Head Diameter	47/46	(38)/-	50/50
Patella			
Max. Length	-/-	-/34	-/43
Max. Breadth	-/-	-/38	-/47
Max. Thickness	20/20	-/16	-/23
Tibia			
Max. Length	382/383	324/-	-/423
Physiological Length	361 /363	306/-	396/396
Platycnemic, Sagittal	39/(38)	27/-	38/36
Platycnemic, Transverse	22/(23)	20/-	23/23
Fibula			
Max. Length	-/-	320/-	-/-

TABLE 10

DISCONTINUOUS TRAITS OF THE SKELETON
/ = left/right, A = absent, P = present
(the first 27 traits are as defined by Molto 1980:252-3)

Trait	Burial #1	Burial #2	Burial #3	Burial #4	Burial #5
Os Japonicum	A/A	-/A	A/A		A/A
Infraorbital Suture	-/-	-/A	P/P		A/P
Tympanic Dehiscence	-/A	P/P	P/P		P/P
Open Spinosum	-/-	A/A	A/A		A/A
Mendosal Suture	A	A	A		A
Marginal Foramen	-/A	A/A	A/A		A/A
Spinobasal Bridge	-/-	P/P	P/P		A/A
Pterygobasal Bridge	-/-	A/A	P/A		P/P
Divided Hypoglossal Canal	-/-	A/A	A/A		A/A
Ossified Apical Ligament	A	A	P		A
Intermediate Condylar Canal	-/-	A/A	A/A		P/P
Clino-Clinoid Bridge	-/-	A/A	A/A		A/A
Caratico-Clinoid Bridge	-/-	A/A	A/A		A/P
Trochlear Spur	P/P	A/A	A/A		A/A
Parietal Foramen	A/A	A/A	A/A		A/A
Post. Condylar Canal	-/-	A/A	P/P		P/P
Frontal Grooves	P/-	-/A	A/A		A/A
Supraorbital Foramen	-/-	P/P	A/A		A/A
Zygomatico-Facial Foramen	P/-	-/A	A/A		P/P
Parietal Process of Temporal	-/-	A/A	A/A		P/A
Accessory Optic Canal	-/-	-/-	A/A		A/A
Lambdic Ossicle	P	P	P		
Lambdoidal Ossicle	-/-	P/P	A/P		A/A
Asterionic Ossicle	-/-	-/-	P/A		A/P
Occipito-Mastoid Ossicle	-/-	-/-	A/A		A/A
Parietal Notch Ossicle	-/-	A/A	A/P		P/P
Pterionic Ossicle	-/-	-/-	A/A		A/A
Sagittal Sinus Direction, Left	A	A	A		A
Multiple Mandibular Foramina	P/P	A/A	P/P	P/P	A/A
Mylohyoid Arch	A/A	A/-	A/A	A/A	P/P
Multiple Mental Foramina	A/A	A/A	A/A	A/A	A/A
Suprascapular Foramen	-/-	-/-	-/A	-/A	-
Acromial Epiphysis	-/-	A/-	P/P	-/A	-/A
Septa] Aperture	A/A	A/A	A/A	P/A	A/A
Third Trochanter	A/A	P/P	-/A	A/-	A/A
Fossa of Allen	A/A	A/A	-/A	A/-	P/P
Vastus Notch	A/A	-/-	-/A	-/A	-/A
Single Ant. Calcaneal Facet	P/P	P/P	A/A	A/-	P/P
Posterior Bridge, Cl	-/A	A/A	A/A	A/A	A/A
Lateral Bridge, Cl	-/A	-/-	A/A	A/A	A/A
Ossified Apical Ligament, C2	A	A	A	-	A
Multiple Foramina Transversaria C3	A/A	-/-	A/A	A/A	A/A
Multiple Foramina Transversaria C4	-/A	A/-	A/P	A/A	-/-
Multiple Foramina Transversaria C5	A/A	A/-	P/P		A/A
Multiple Foramina Transversaria C6	-/-	A/-	P/P	A/A	-/A
Multiple Foramina Transversaria C7	A/A	-/-	P/P	-/-	A/P
Spondylolysis, L5	A	-	A		P
Sacralized Lumbar	A	A	A		A

TABLE 11

DISCONTINUOUS TRAITS OF THE PERMANENT DENTITION
/ = Left/right, A = Absent, P = Present

Trait	Tooth	Burial #1	Burial #3	Burial #4	Burial #5
Shovel Shaping	I'	P/P	P/P	P/P	-/-
(any)	1^2	P/P	P/P	-/P	-/-
Tuberculum Dentale	I'	P/P	P/P	A/A	-/-
(any)	1^2	A/A	P/P	-/P	-/-
Disto-Lingual Cusp.	M'	P/P	P/P	-/-	P/-
(≥1/2 other cusps)	M^2	A/A	P/P	-/P	P/A
Carabell's Cusp	M'	A/A	A/A	A/A	A/A
(any)	M^2	A/A	A/A	A/A	A/A
Paramolar Cusp	P'	-/P	P/P	A/A	-/-
(any)	P^2	A/A	A/A	A/A	-/-
" Y " Pattern	M_1	A/A	P/P	P/P	-/-
	M_2	A/A	A/A	-/A	-/-
Distal Cusp	M_1	P/P	P/P	P/P	-/-
(≥ 1/2 other cusps)	M_2	-/P	A/A	A/A	-/-
Tuberculum Sextum	M_1	A/A	P/P	-/-	-/-
(any)	M_2	-/A	-/-	-/-	-/-
Tuberculum Intermedium	M_1	A/A	A/A	P/P	-/-
(any)	M_2	A/A	A/A	A/A	-/-

Reburial is certainly not recommended from a scientific viewpoint. I have no illusions that this analysis will be adequate for all times. While I believe it to be minimally adequate for the moment, the new methods (e.g. Van der Merwe and Vogel 1978 on stable carbon isotopes; Brown 1973, Schoeninger 1979 and Katzenberg 1983 on strontium and other trace metals; Myers 1968 on alizarin and tetracycline binding; et al) and critical approaches to observational error (e.g. Molto 1980; Utermohle, Zegura and Heathcote 1983, et al) have been significant in recent years. The potential loss of information regarding prehistoric peoples is undoubtedly great, and this loss will become cumulative with time.

ACKNOWLEDGEMENTS

This research was funded in part by Erindale College which provided the facilities and equipment and in part by the Social Sciences and Humanities Council of Canada, the Ontario Heritage Foundation, and Wilfrid Laurier University which supported the excavation.

I also acknowledge Dr. Dean Knight, Director of the Ball Site excavation. Without his scrupulous excavation and accurate notes this analysis would be much less. I would like to thank Dr. Anne Katzenberg and Dr. Hermann Helmuth for their comments on earlier versions of this manuscript. Finally, I thank Ms. Clara Stewart who has endured my unending revisions in typing this manuscript.

REFERENCES CITED

Anderson, J.E.
1964 The People of Fairty. *National Museum of Canada Bulletin* 193:28-129.

Brown, A.
1973 Bone Strontium Content as a Dietary Indicator in Human Skeletal Populations. Unpublished PhD dissertation, Department of Anthropology, University of Michigan, Ann Arbor, Michigan.

Buikstra, J.E. (editor)
1981 *Prehistoric Tuberculosis in the Americas.* Northwestern University Archeological Program. Evanston, Illinois.

Butler, R.J.
1972 Age-related Variability in Occlusal Wear Planes. *American Journal of Physical Anthropology* 36:381-390.

Hartney, P.C.
1981 Tuberculous Lesions in a Prehistoric Population Sample from Southern Ontario. In *Prehistoric Tuberculosis in the Americas* (edited by J.E. Buikstra), pp. 141-160. Northwestern University Archeological Program. Evanston, Illinois.

Kapches, M.
1976 The Interment of Infants of the Ontario Iroquois. *Ontario Archaeology* 27:29-39.

Katzenberg, M.A.
1977 An Investigation of Spinal Disease in a Midwest Aboriginal Population. *1976 Yearbook of Physical Anthropology* 20:349-355.
1983 Chemical Analysis of Prehistoric Human Bone from Five Temporally Distinct Populations in Southern Ontario. Unpublished PhD dissertation, Department of Anthropology, University of Toronto, Toronto, Ontario.

Katzenberg, M.A., and R. White
1979 A Palaeodemographic Analysis of the *Os Coxae* from Ossossane Ossuary. *Canadian Review of Physical Anthropology* 1:10-28.

Knight, D., and J. Melbye
1983 Burial Patterns at the Ball Site. *Ontario Archaeology.* 40:37-48.

Knight, D., and M. Snyder
1981 The 1981 Excavations at the Ball Site. Report on file at the Department of Sociology and Anthropology, Wilfrid Laurier University, Waterloo, Ontario.

McKern, T., and T.D. Stewart
1957 *Skeletal Age Changes in Young American Males.* Headquarters, Quartermaster Research and Development Command, Technical Report EP-45. Natick, Massachusetts.

Merchant, V., and D. Ubelaker
1977 Skeletal Growth of the Protohistoric Arikara. *American Journal of Physical Anthropology* 46:61-72.

Miles, A.E.W.
1963 Dentition in the Assessment of Individual Age in Skeletal Material. In *Dental Anthropology* (edited by D.R. Brothwell), pp. 191-209. Pergamon Press.

Molto, J.E.
1980 Biological Relationships of Southern Ontario Woodland Peoples: The Evidence of Discontinuous Cranial Morphology. Unpublished PhD dissertation, Department of Anthropology, University of Toronto, Toronto, Ontario.

Montagu, A.
1960 *An Introduction to Physical Anthropology* (third edition). Charles C. Thomas.

Moorees, C., E. Fanning and E. Hunt
1963a Formation and Resorption of Three Deciduous Teeth in Children. *American Journal of Physical Anthropology* 21:205-213.
1963b Age Variation of Formation Stages for Ten Permanent Teeth. *Journal of Dental Research* 42:1490-1502.

Morse, D.
1961 Prehistoric Tuberculosis in America. *American Review of Respiratory Diseases* 83:489-504.

Myers, H.M.
1968 Alizarin and Tetracycline Binding by Bone Mineral. *American Journal of Physical Anthropology* 29:179-182.

Nowell, G.W.
1978 An Evaluation of the Miles Method of Ageing Using the Tepe Hissar Dental Sample. *American Journal of Physical Anthropology* 49:271-276.

Ortner, D., and W. Putschar
1981 Identification of Pathological Conditions in Human Skeletal Remains. *Smithsonian Contributions to Anthropology* 28. Washington, D.C.

Palmer, C.
1891 Palmer's Dental Variation. *The Dental Cosmos* 33:194-198.

Phenice, T.
1969 A Newly Developed Visual Method of Sexing the Os Pubis. *American Journal of Physical Anthropology* 30:297-301.

Schoeninger, M.
1979 Diet and Status at Chalcatzingo: Some Empirical and Technical Aspects of Strontium Analysis. *American Journal of Physical Anthropology* 51:295-310.

Schour, I., and M. Massler
1944 *Development of the Human Dentition.* A Chart (second edition). American Dental Association Chicago.

Schwarcz, H.P., M.A. Katzenberg, M. Knyf, and J. Melbye
1983 Analysis of Stable Isotopes of Carbon and Nitrogen in Prehistoric Southern Ontario Populations. Paper presented to the Xlth International Congress of Anthropological and Ethnological Sciences, Vancouver, British Columbia, Canada.

Steinbock, R.T.
1976 *Paleopathological Diagnosis and Interpretation: Bone Diseases in Ancient Human Populations.* Thomas.

Sykes, C.M.
1983 An Archaeological and Ethnohistorical Analysis of Huron Intracommunity Exchange Systems. Unpublished PhD dissertation, Department of Anthropology, University of Toronto, Toronto, Ontario.

Todd, T.W.
1920 Age Changes in the Pubic Bone. *American Journal of Physical Anthropology* 3:285-334.

Trotter, M., and G. Gleser
1958 A Pre-Evaluation of Estimation of Stature Based on Measurements of Stature Taken During Life and of Long Bones After Death. *American Journal of Physical Anthropology* 16:79-123.

Ubelaker, D.
1978 *Human Skeletal Remains: Excavation, Analysis, Interpretation.* Aldine.

Utermohle, C.J., S.L. Zegura and G.M. Heathcote
1983 Multiple Observers, Humidity, and Choice of Precision Statistics: Factors Influencing Craniometric Data Quality. *American Journal of Physical Anthropology* 61:85-95.

Van der Merwe, N.J., and J.C. Vogel
1978 '^{3}C Content of Human Collagen as a Measure of Prehistoric Diet in Woodland North America. *Nature* 276:815-816.

Whitman, R.
1927 *Treatise on Orthopaedic Surgery.* Lea and Febiger.

Wright, J.V.
1966 The Ontario Iroquois Tradition. *National Museum of Canada Bulletin* 210.

Department of Anthropology
Erindale College, University of Toronto
Mississauga, Ontario L5L 106