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Anthropological Investigations on An Iron Age Adult Male Skeleton from S. Pappinayakkanpatti, Madurai District, Tamil Nadu

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KEY WORDS Iron-Age Adult. Anthropometry. Pathology. Life Style.

ABSTRACT This paper presents an account of morphometric and pathological observations made on a skeleton recovered from the Iron Age habitation-cum-burial site at S. Pappinayakkanpatti. The individual represented is a middle aged adult male. Robustness exhibited by this individual reflects the rigorous life style and mixed food habits. The notable pathology is a wound scar on the parietal, possibly caused by a flat and sharp metal weapon. Dental pathologies like attrition, caries and tartar accumulation have also been noticed.

A middle-aged adult male skeleton was recovered from the Iron Age habitation-cum-burial site at S.Pappinayakkanpatti in May 1994. This paper presents an account of morphometric and pathological observations made on this skeleton.

ARCHAEOLOGICAL CONTEXT

S.Pappinayakkanpatti, Lat. 77° 42' 11" East, Long. 9° 48' 52" North, is a small village located 12 km northwest of Peraiyur in Madurai district of Tamil Nadu (Fig.1). An Iron Age (Megalithic) habitation-cum-burial site was discovered in September 1992 by the second author during the course of surface survey carried out as a part of his doctoral research. The site lies about one km southwest of the village at the foot of a small hillock. The habitation area is on the south eastern side of the hillock and covers an area of about three acres, while the burial site, measuring about four acres, is located 100 m north of the habitation area. The site, especially the burial locality, is considerably disturbed because of the on going agricultural activities. The extent of distribution of the artifacts exposed from the disturbed burials suggests that the burial area could have had more than 100 burials; but, at present the site preserves only around 30 burials in a relatively undisturbed state. Urn burial with cairn-circle appendage is the commonly occurring burial type.

The habitation area yields black-and-red, russet-coated and painted, and red ware pottery. Evidence for iron smelting was also found in the form of ores, slags and *terra-cotta* pipes. No radiometric date is available for this site yet; however, it may be noted that the Iron Age sites in this region are placed in the temporal span of fourth century B.C. to fourth century A.D. (Ramachandran, 1980).

An urn burial located on the eastern foot of the hillock was exposed in May 1994 (Fig.2). The upper part of the burial was disturbed partially by agricultural activities. The urn, with a maximum diameter of 55 cm and a height of 95 cm, contained an adult male skeleton. Owing to the disturbed condition of the contents of the burial, no precise comment can be made about the articulation of the skeleton. However, since the skull was resting inversely above the pelvic bones, it can be construed that the individual was buried in a sitting posture. As most of the skeletal elements are represented, the burial appears to be primary in nature. The burial was devoid of any grave goods.

PRESERVATION AND SKELETAL INVENTORY

The adult male individual is represented by fairly complete cranial and post-cranial elements. The skeleton is relatively unweathered, but suffers from heavy post-mortem damage resulting in the loss of many long bone epiphyses as well as many bones of the facial skeleton.

The neurocranium is almost complete (Fig. 3 - 5) except for the basal portion and the left side of the frontal bone, as a result of the damage occurred during the excavation process. The glabellar portion and almost half of the superi-

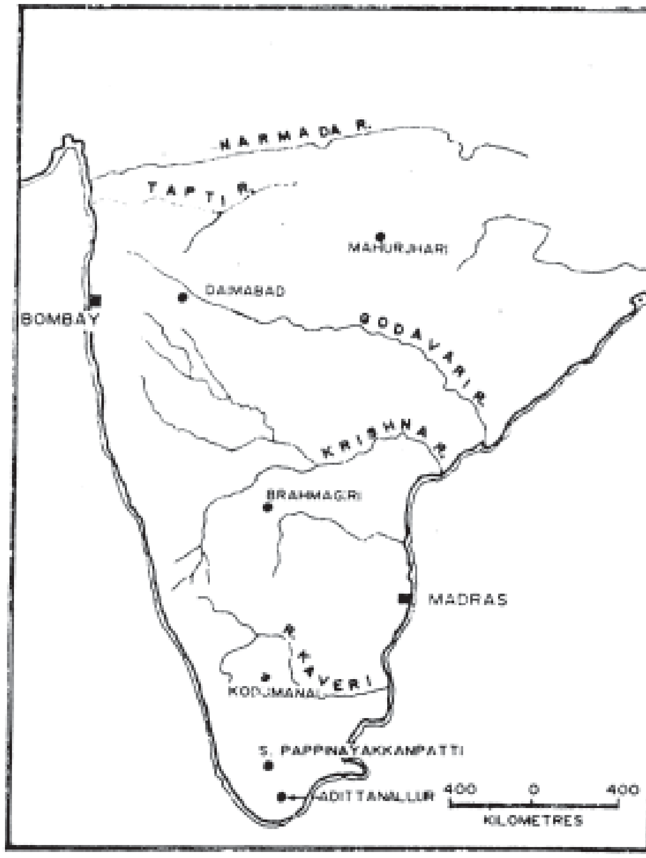

Fig. 1. Map showing the location of the site

or orbital ridges along with the nasal bones and a portion of right maxilla are present. The facial bones cannot be articulated to the vault, as some fragments are missing. Slight damage has also occurred to the right mastoid process. Foramen magnum is complete posteriorly and laterally; the basion portion of the foramen magnum is present, but cannot be joined. The left parietal, approximately two cm anterio-laterally to lambdoid, suffers an extensive scar of wound injury, most probably caused by a sharp and flat metal weapon. The injury has resulted in the loss of approximately 4 sq. cm area of bone. The outer table of around 1.5 to 2 cm along the lateral and posterior border of the wound is lost, whereas in the anterior edge the wound shows normal bone thickness (Fig.5 and 6).

The inventory of the facial skeleton includes the following: right and left nasal bones; right and left maxillary bones, of which the left side is better preserved; palatal bones of either side; zygomatic bone of the left side; and, numerous small-sized fragments of orbital area. Left eye socket and the nasal aperture are completely preserved. The right eye socket is complete medially and superiorly, but the lateral and inferior borders are not intact. Though the zygomatic arches are broken on both sides, the presence of zygomatic processes of temporals allow a fair estimate of facial breadth. The left and right maxilla preserve, respectively, six and five teeth, *in situ*. The mandible is complete, but for the loss of right coronoid process (Fig.7) and it retains all the teeth except incisors.

The Dental Inventory Includes the Following:

Maxillary : RI1 and RLI2 (isolated); LC,

Fig. 2. View of the burial

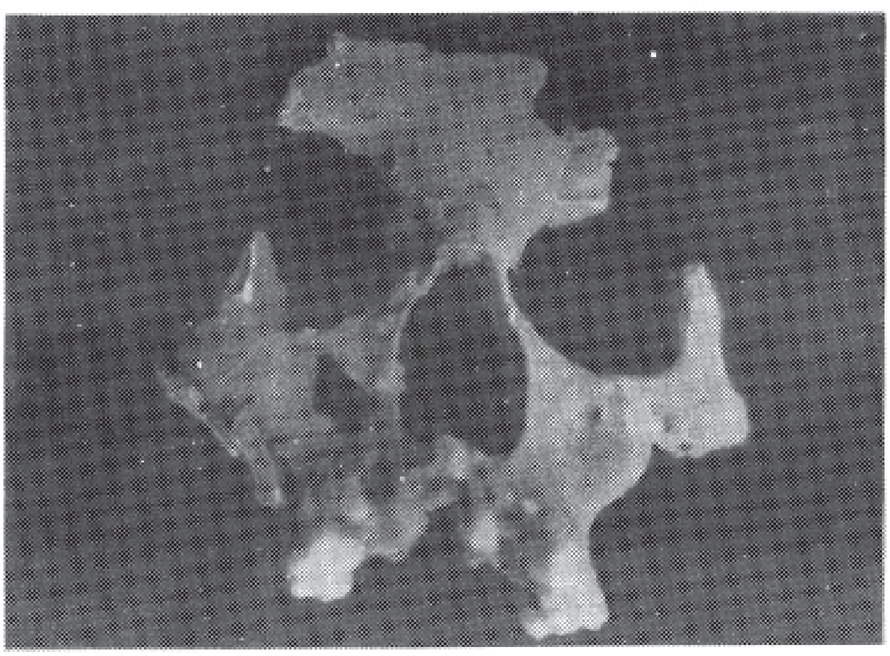

Fig. 3. Facial skeleton

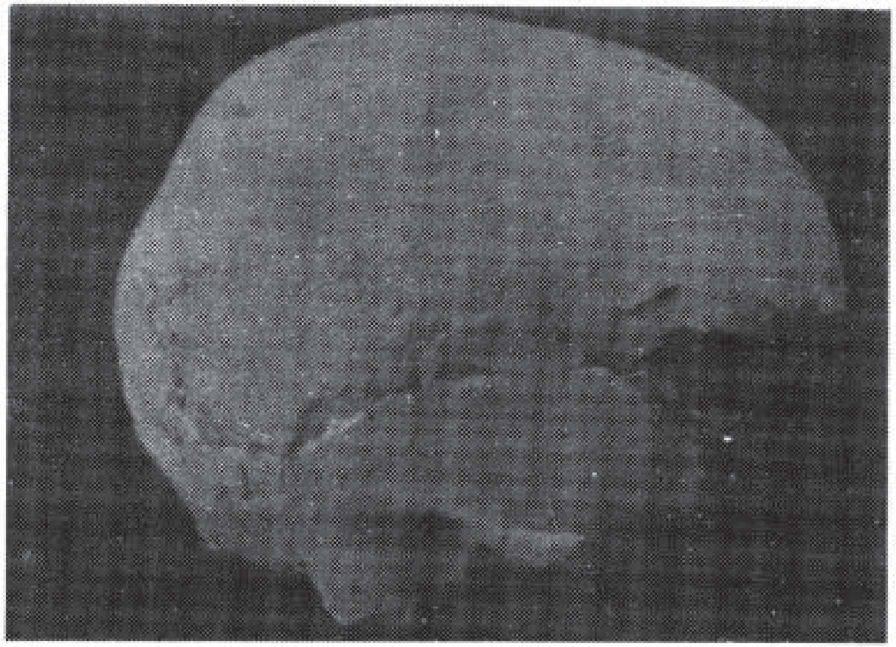

Fig. 4. Neurocranium, *Norma lateralis*

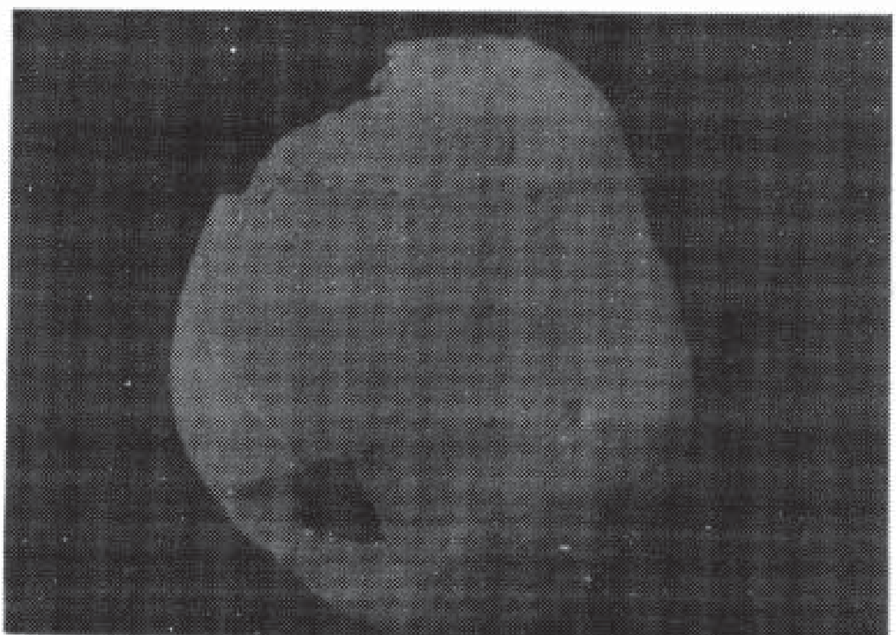

Fig. 5. Neurocranium, *Norma verticalis*

RLPm3 (crown of left premolar is broken), RLPm4, RLM1, RLM2, RLM3.

Mandibular : All teeth except RLI1 and RLI2 are preserved *in situ*.

Most of the post-cranial elements are preserved in a fairly good state in the mid-shaft region, but heavy damage has occurred to the epiphyses. Several rib fragments, neural arches, vertebral bodies and metabones are present, but have not been identified individually. Other elements preserved include the following:

Shoulder Girdle : Left scapula is represented by a complete lateral margin with a part of coracoid and a fairly complete acromion; the glenoid region is damaged. Supra- and infraspinous fossae are preserved along with one-third of the axillary border. Scapular blade is broken into several small-sized fragments which are beyond reconstruction. Right scapular fragments include complete glenoid and approximately two cm of the inferior blade and acromion. No measurement is possible, since these scapulary pieces cannot be articulated.

Left clavicle is complete with a slight damage to the acromial end, and its counterpart is missing.

Bones of the Upper Extremities :

Right humerus is complete in the shaft region and distal epiphysis, but broken at the neck. Left humerus is also complete, except for the proximal end; medial epicondyle is slightly broken; parts of greater and lesser tuberosity are present, but cannot be articulated with the shaft.

Right ulna is fairly complete but for the broken coronoid process and a part of the ulnar tuberosity. Olecranon process is broken, but the radial notch is preserved completely and the trochlear notch, partially. Distal end of this bone is well preserved. For the left ulna, the proximal end is complete so as the shaft; two pieces cannot be articulated, as few fragments are missing. Distal end of this bone is absent.

Left radius is complete with a slight damage to the distal end, and for the right radius only shaft is present.

Pelvic girdle is represented by both right and left innominates, the right side bone is more complete than that of the left. Right innominate has partially preserved pubis, complete acetabulum and almost two-thirds of iliac blade. Sciatic notch is well preserved. Ischial tuberosity is also present, but cannot be articulated. Left innominate also has complete iliac blade, acetabulum and sciatic notch, but is extremely fragmentary.

Bones of Lower Extremities :

Proximal femoral ends and shafts for both sides are present, right side is better preserved than the left.

Patellar Bones are missing for Both Sides :

Right tibial shaft is more complete than that of the left. Proximal ends are broken, while the distal ends are in good condition.

Right fibula is complete. For the left side, proximal end is preserved so also a portion of the mid-shaft region.

Description of the Cranial Bones

The individual represented is quite robust. The rugose features are manifested as pronounced glabellar region and superior orbital ridges. The vault is moderately broad (mesocranial) with a cranial index of 77.77. The nuchal area of occipital bone is well marked indicating powerful neck muscles. The mastoid processes are robust with deep post-temporal fossa. The glenoid cavity is deep. The orbits are widely separated and are oblong in shape (hypsiconch, with an orbital index of 87.50). The orbital margins are moderately thick. The nasal aperture is broad with a prominent nasal spine. The nasal bones exhibit slight depression at the root which is a very common feature in protohistoric populations of Peninsular India. The nasal index is 55.77, which falls in chamaerhinae range. Palate is broad (palatal index 85.71, brachystaphylin) and of moderate height (palatal height index 30.95, orthostaphylin). Infra-orbital foramen (left side) is deep. Supra-orbital foramen (right side) is complete. The maxillary bones cannot be articulated with the neurocranium, but the rough assessment suggests that the face is straight (orthognathus) with slightly projecting jaw bones (alveolar prognathism). Face appears short with a total facial index of 77.93 (euryprosopic) and an upper facial index of 46.90 (euryen).

Mandible is broad and strongly built with a prominent chin and slightly everted gonia. Condyles are strong which justify the deep gle-

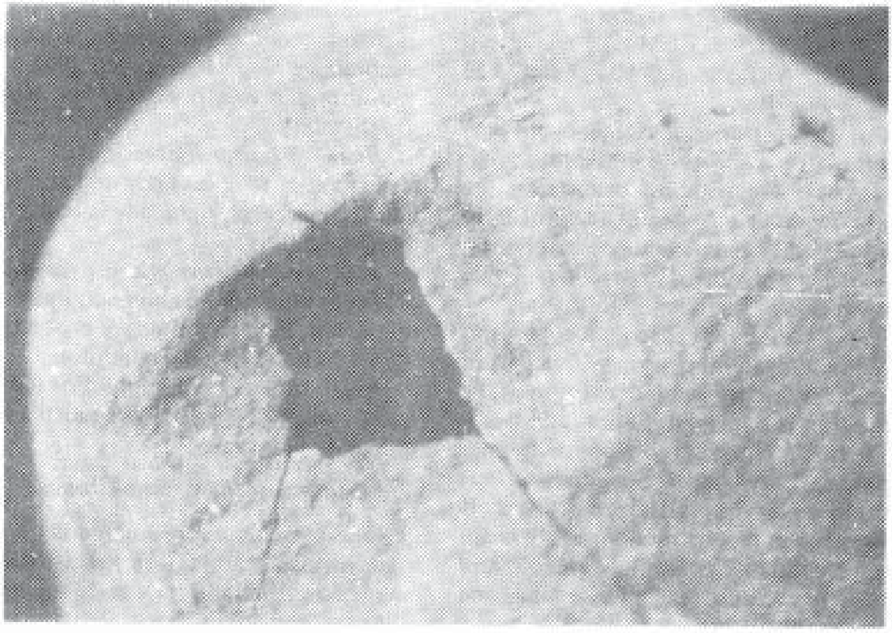

Fig. 6. Close-up of the scar of the injury

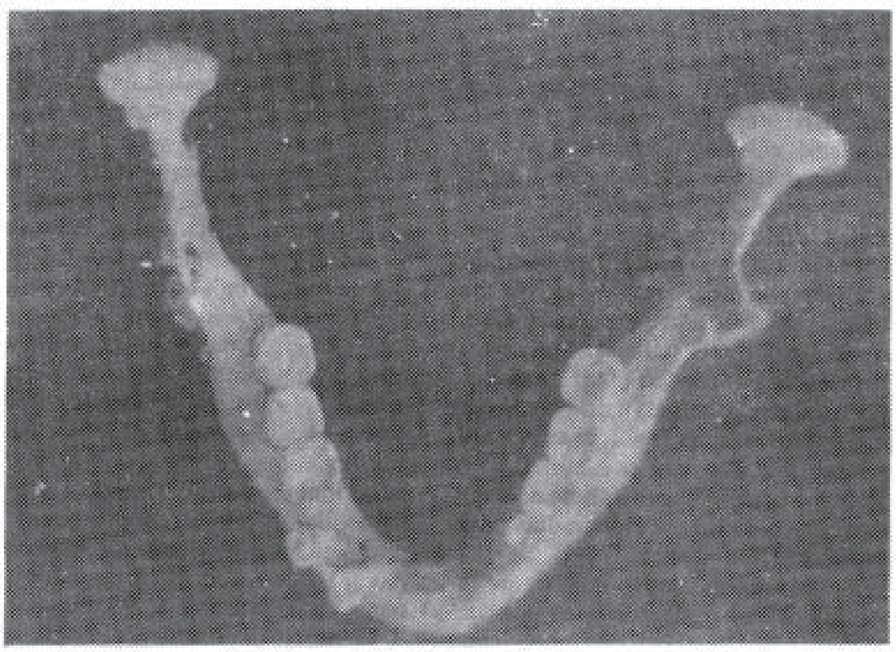

Fig. 7. Mandible, occlusal view

noid cavities. Mylo-hyoid groove is deep. Mandibular index is 61.54 (dolichosteno).

The craniometric data is presented in table 1.

Table 1 : Craniometric data

(Martin-Saller code is given in parenthesis immediately after the measurement/index. Unless otherwise specified, all measurements are recorded in millimetre. Estimates are bracketed. Though original references for classifying measurements/indices are given, the classification is based on the standardized system of Martin-Saller 1957.)

Measurement / Index (M.S.code)	*Value*
A. Length Measurements on Neurocranium	
Maximum cranial length (1)	(180)
Glabella inion length (2)	(174)
Nasion inion length (2a)	(170)
Glabella lambda length (3)	(156)
Length of foramen magnum (7)	(30)
B. Breadth Measurements on Neurocranium	
Maximum cranial breadth (8)	140
Minimum frontal breadth (9)	(104)
Maximum frontal breadth (10)	115
Bi-auricular breadth (11)	119
Greatest occipital breadth, asterionic breadth (12)	110
Bi-mastoid breadth (13)	107
C. Height Measurements on Neurocranium	
Auriculo bregmatic height (20)	118
Porion (auriculo) vertex height(21)	116
Parietal perpendicular height [22f]	30
Occipital perpendicular height [22g]	25
Calvarial height (22)	(110)
D. Circumference, Arc and Chord Measurements	
Horizontal circumference of skull (23)	(540)
Transverse arc (24b)	330
Longitudinal arc (25)	(340)
Frontal arc (26)	(115)
Parietal arc (27)	128
Occipital arc (28)	107
Parietal chord (30)	109
Occipital chord (31)	91
E. Breadth Measurements on Face	
Bizygomatic breadth (45)	(145)
F. Height Measurements on Face	
Total facial height (47)	(113)
Upper facial height (48)	(68)
G. Measurements on Orbit and Inter-orbital region	
Anterior inter-orbital breadth (50)	27
Orbital breadth, left (51)	(40)
Orbital height, left (52)	(35)
H. Measurements on Nasal Region	
Nasal breadth (54)	(29)

Table 1 : Contd....

Measurement / Index (M.S.code)	*Value*
Nasal height (55)	52
I. Measurements on Upper Jaw and Palate	
Breadth of maxilla (61)	57
Sub-nasal height (48-1)	14
Palatal length (62)	49
Palatal breadth (63)	42
Palatal height (64)	13
External palatal arc	340
Molar teeth row length (80-3), left	24
Premolar teeth row length [80-3a], left	14
J. Measurements on Lower Jaw	
Bi-condylar breadth (65)	130
Bi-coronoid breadth (65-1)	(100)
Bi-gonial breadth (66)	104
Bi-mental breadth, anterior breadth (67)	45
Length of lower jaw (68)	80
Condylo-symphyseal length (68-1), right	113
left	112
Gnathion-gonion length, right	98
left	96
Chin height, symphyseal height (69)	30
Condylar height, height of ascending ramus (70), right	60
left	61
Height of coronoid (70-1), left	60
Ascending ramus minimum breadth (71), right	33
left	32
Ascending ramus maximum breadth (71-1), left	39
Condylo-coronoid breadth, left	32
External mandibular arc (80a)	198
Molar teeth row length [80-1a], right	35
left	34
Premolar teeth row length [80-b], right	13
left	13
K. Angles	
Metopic angle, profile angle of forehead (32)	(80°)
Calvarial base angle	(10°)
Glabella-inion angle	12°
Lambda-inion angle	(75°)
Bregma angle of Schwalbe (32-1)	(65°)
Lambda angle of Schwalbe	(90°)
Mandibular angle, gonial angle (79), right	120°
left	120°
Chin angle (Oetteking 1945)	85°
Mento-basal angle of mandible (Oetteking, 1945)	70°
Anteriobasal angle of mandible (Oetteking, 1945)	75°
Basal angle of mandible (Oetteking, 1945)	(9°)
Posteriobasal angle of mandible (Oetteking, 1945)	(115°)
Ramus angle of mandible (Oetteking, 1945)	75°
Condylo-coronoid angle of mandible (Oetteking, 1945)	10°

Table 1 : Contd....

Measurement / Index (M.S.code)	*Value*
I. Indices	
Cranial capacity (Lee-Pearson, 1901) Using auriculo-bregma height	(38)
Cranial index (I 1)	77.77
Range variation (Garson, 1886)	Mesocranial
Auriculo-vertical index (I 4)	65.56
Range variation (Martin-Saller, 1957)	Hypsicranial
Calvarial height-breadth index (I 6)	61.11
Sagittal arc index (I 10)	50.00
Transverse frontal index (I 12)	90.43
Transverse fronto breadth index, frontal index (I 13)	74.29
Range variation (Martin-Saller, 1957)	Eurymetopic
Sagittal parietal index (I 24)	85.16
Sagittal occipital index (I 25)	85.05
Total facial index (I 38)	77.93
Range variation (Martin-Saller, 1957)	Euryprosopic
Kollman's upper facial index (I 39)	46.90
Range variation (Martin-Saller, 1957)	Euryen
Jugo-mandibular index (I 40)	71.72
Orbital index (I 42)	87.50
Range variation (Martin-Saller, 1957)	Hypsiconch
Nasal index (I 48)	55.77
Range variation (Martin-Saller, 1957)	Chamaerhinae
Palatal index (I 58)	85.71
Range variation (Martin-Saller, 1957)	Brachystaphylin
Palatal height index (I 59)	30.95
Range variation (Bauer, quoted Martin-Saller, 1957)	Orthostaphylin
Mandibular index (I 62)	61.54
Range variation (Lindegard-Sonesson, quoted Martin-Saller, 1957)	Dolichosteno-mandibular
Condylar index (I 63)	55.00
Gonio-condylar index (I 64)	80.00
Vertical cranio-facial index (I 70)	60.18
Transverse cranio-facial index (I 71)	103.57
Jugo-frontal index (I 73)	71.72

Cranial Pathology

As mentioned earlier, the left parietal suffers an extensive scar of wound injury probably caused by a sharp and flat metal weapon.

In palaeopathology literature, 'fracture' is defined as a traumatic event that results in partial or complete discontinuity of a bone (Ortner and Putschar 1981). Causes for bone fracture can be due to varied factors such as twisting, dynamic stress, bending, compression, tension, shearing, etc. The fracture under discussion is due to a stress of dynamic nature, meaning a sudden high stress. Each type of dynamic stress produces a different type of fracture. The traumatic condition in this case is, most probably, due to a wound incurred by a sharp and flat metal weapon like sword or axe. The blow of the weapon appears to be from the rear side, as evidenced by the slice of the outer table on the latero-posterior edge of the wound. Along the anterior edge the bone is of normal thickness indicating that the blow was not strong enough to slice off the bone completely. Such type of injuries are more commonly seen on left parietal, if the assault is from the back side and on the right frontal, if the attack is from the front (Roberts and Manchester, 1995). This feature can be attributed to the right handedness of the majority of the people.

The injury is quite deep, probably penetrating the soft tissue of the brain. While it is quite likely that the incidence proved fatal, death might not have been instantaneous. The thin bone of the inner table exhibits considerable amount of secondary lamellar bone formation, suggesting the survival of the victim for some period, anywhere between fifteen days to three months, after the incident. Probably, the complications of post-traumatic infections were more serious considering the openness of the wound. Since the healing process was still in progress at the time of death, there is every reason to suspect that the soft tissue in the fractured area might have been a locus for secondary infection. A rusted iron weapon can definitely lead to such type of infection, a possibility that cannot be ruled out in this case. Since the individual survived at least for a few days after the injury, there is a possibility that some kind of treatment was given.

DESCRIPTION OF DENTAL ELEMENTS

The teeth exhibit various grades of moderate to severe attrition precluding morphological observations for some.

The maxillary right central incisor and the lateral incisors of either side, show no trace of shoveling. The first molars have very large hypocone of grade 5, whereas the second molars have a small hypoconal cusp of grade 3 (Larson, 1978); the third molars are devoid of hypocone.

The mandibular first molars are completely worn out resulting in complete obliteration of the occlusal cusps and groove configuration. The second and third molars of both sides have +4 type of occlusal morphology of cusp and groove pattern (Hellman, 1928).

Maxillary second molars are larger than the first. In mandibular molar row, the third molars are the largest and the first molars are the smallest (*i.e.* M2 > M1 > M3 for maxilla and M3 > M2 > M1 for mandible). Generally, the first molars are the largest and the third molars are the smallest in the series. The pattern observed in this individual does not have any pathological significance; but more likely appears to be of genetical nature.

As mentioned earlier, the dental elements show a high degree of occlusal wear.

The maxillary central incisor shows wear pattern of grade 5 (Smith, 1984). The lateral incisors are slightly worn out and exhibit a hair line of dentine exposure. The right side premolars and molars show higher degree of attrition than their left antemeres. First molar of the right side has lost the enamel coating completely exposing the secondary dentine, grade 10, while the left first molar has dentine exposure on one-fourth of its occlusal quadrant, grade 5 (Scott, 1979). The second and third molars show relatively less dentine exposure.

The mandibular teeth exhibit bilateral disparity in attrition rates for anterior and posterior teeth. Canine and premolars of the right side are more worn out than the left. Molars of the left side are more severely damaged than their right antemeres. The gradation pattern of attrition is given in table 2.

The enamel surfaces of three maxillary teeth show severe enamel chipping. The central incisor has lost almost half of the enamel surface on its lingual surface. The Left first and right

Table 2 : Attrition gradation pattern for mandibular teeth (after Scott, 1979)

Tooth	*Right*	*Left*
C	4	2
Pm1	4	2
Pm2	5	2
M1	10	9
M2	9	7
M3	3	3

second molars also exhibit enamel chipping on the lingual surface.

The exposed dentine of the maxillary central incisor might have been a locus for caries infection. The right maxillary molar as well as the right and left mandibular first molars (RM^1 and RLM_1) also exhibit initial stages of caries formation in the area of dentine exposure.

The molar teeth have slight to moderate calculus and plaque formation, but the exact degree of pathology cannot be determined because of calcrete formation.

The science of dental pathology is defined as a study of the origin, nature and causes of dental diseases (Lukacs, 1989). It is a valuable tool to illustrate the complexities of bio-cultural (or genetic-environmental) interactions in prehistoric human populations. It provides meaningful data for reconstructing the general health status of the population and decipherment of the specific biological adaptations in response to the cultural or ecological stresses. In the Indian context, the dental anthropological research has a significant role in explaining the biological implications of cultural change from food-gathering to food-producing stage. However, such bio-cultural interpretations of dental pathology are extremely sporadic in Indian anthropology.

Most of the teeth of this individual show moderate to severe attrition (Fig.8). Dental attrition is a gradual and regular loss of tooth substance as a result of natural mastication (Pindborg, 1970). It is a mechanical process which reflects the dietary and occupation related habits of the individual. If the 'normal' rate of attrition is increased, it is termed 'intensified'. Such type of attrition of the occlusal surface destroys the enamel exposing the underlying dentine, a condition evident in this case. Dental attrition is a well-known and most commonly reported phenomenon in majority of the skeletons from the archaeological sites. Most of the young-, middle aged- and old-adults generally possess moderately or heavily worn teeth. In such cases, secondary dentine, especially on molar teeth, is often exposed resulting in obliteration of occlusal features.

Bilateral attrition disparity seen on the molars reflects the chewing habits of this individual. Heavy wear on the left side indicates that the individual had preference for left side in masticating food.

Attrition of anterior teeth, especially maxillary incisors, can be attributed to culture related factors. The use of anterior teeth to hold abrading instruments, such as pipe, or other type of objects also results in an uneven or aberrant type of dental attrition, as seen in this case, and is certainly not related to the chewing habits of the individual. Occupations, such as bamboo basket making, which require the frequent use of anterior teeth can also cause similar type of attrition, a possibility that cannot be ruled out in this case.

For holding objects in mouth generally right side is preferred and it is related to handedness. Since majority of the people are right handed, there is more possibility of using right side of the dentition for holding objects. More wear of right side canine and premolars in this individual might be indicative of such preference. Enamel chipping seen on the maxillary right central incisor (RI^1) can also be attributed to such occupational stress. Moreover, the lesion is on the lingual aspect of this tooth which is normally least affected by masticatory pressure. On the other hand, enamel loss on left first and right second molars (LM^1 and RM^2) is related to the frequency and kind of abrasives present in the diet.

The high attrition coupled with tooth cracks or enamel chips is generally attributed to the intake of hard and unprocessed food which is common in hunting-gathering communities. The presence of finely ground abrasives in the diet may also result in severe attrition, but with relatively less enamel chipping. The early agricultural societies have this kind of occlusal wear pattern indicating that food was processed. The nature of chipping and attrition shows that the population of S. Pappinayakkanpatti probably consumed both domesticated and wild varieties of flora and fauna.

Besides masticatory and occupation related loss of enamel, the other noteworthy pathology is the caries infestation on the maxillary right first and mandibular right and left first molars (RM^1 and RLM_1).

Caries are defined as an infectious and transmissible disease in which progressive destruction of tooth structure is initiated by microbial activity on the tooth surface (Pindborg, 1970). Food particles entrapped in the inter-cuspal fissures of the tooth crown provide ideal microenvironments for the reproductive and destructive activities of the acidogenic micro-organisms. Increase in caries rate is roughly in proportion to the increase of cereal carbohydrates in the diet. Increased carious lesions in agricultural populations are associated with a shift to high carbohydrate diets and food processing techniques. Consumption of porridges and other boiled foods, which are more sticky, are certainly cariogenic. Evidence of grinding implements and ceramics reported from contemporary sites and references from the classical Tamil literature (Singaravelu, 1966) indirectly support the contention that food was processed during the Iron Age.

Dental attrition, if moderate, often proves to be protective against caries infection, since it results in the grinding of occlusal surfaces before dental caries can develop. It reduces and removes the occlusal stagnation areas that are generally predisposed to caries. If the wear is severe destroying the enamel layer and exposing the pulp cavity, caries gradually and effectively destroy buccal moity of the crown and penetrate deep into the dentine or pulp cavity.

Another common irritant found in this specimen is calculus deposition on the dental elements. Calculus and its precursor, bacterial plaque, consists of a sticky coating including protein, food particles, living and dead microorganisms. When plaque mineralizes, it becomes calculus and its occurrence can be found on archaeological skeletal specimens as relatively hard additions to the tooth surface usually at the margins of the gums. The role of calculus in periodontal diseases is not clear. Nevertheless, the presence of calculus on dental tissues is an important factor to evaluate the irritation of gum tissue and also a possible cause for periodontal diseases. Cases of calculus deposition are very common in archaeological dentition. It often coexists with severe attrition and is related to poor dental hygiene.

The odontometric data is presented in table 3. Measurements are taken following a standard

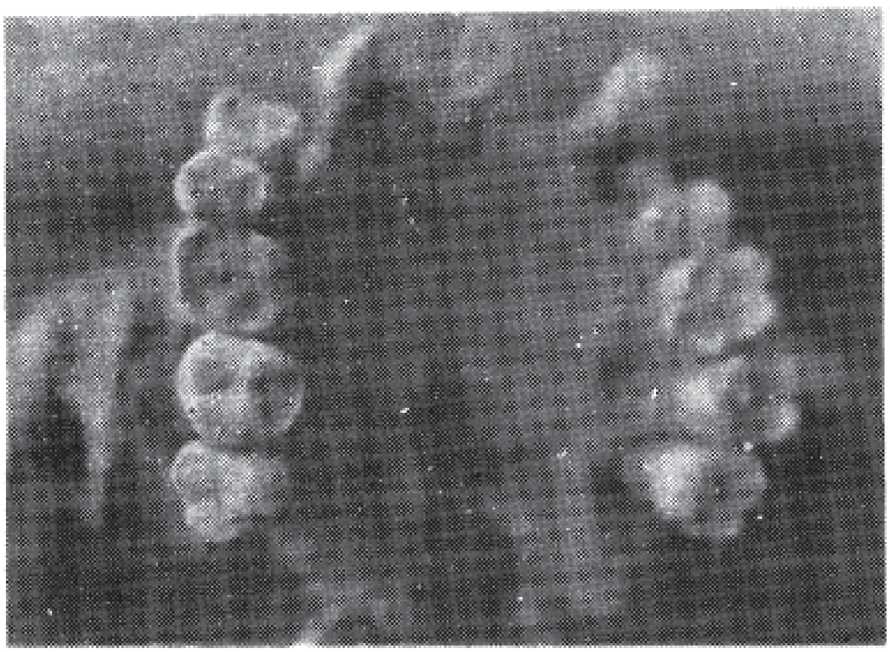

Fig. 8. Maxillary dentition, note pathologies on the right side

Table 3 : Dental crown dimensions and indices

Tooth	*Side*	*Crown dimensions*		*Crown indices*		
		MD	*BL*	*CA*	*CI*	*CM*
Maxilla						
I1	R	8.36	7.29	60.94	114.68	7.83
I2	R	6.47	6.33	40.96	102.21	6.40
	L	6.44	6.42	41.34	100.31	6.43
C	L	7.14	8.45	60.33	84.50	7.80
Pm1	R	7.07	9.16	64.76	77.18	8.12
Pm2	R	6.93	9.12	63.20	75.99	8.03
	L	6.99	9.18	64.17	76.14	8.09
M1	R	10.30	11.12	114.54	92.63	10.71
	L	10.29	11.18	115.04	92.04	10.74
M2	R	10.42	10.95	114.10	95.16	10.69
	L	10.35	11.03	114.16	93.83	10.69
M3	R	9.98	10.44	104.19	95.59	10.21
	L	10.01	10.35	103.60	96.71	10.18
Mandible						
C	R	6.51	7.38	48.04	88.21	6.95
	L	6.67	7.39	49.29	90.26	7.03
Pm1	R	7.11	7.98	56.74	89.10	7.55
	L	7.20	8.08	58.18	89.11	7.64
Pm2	R	7.44	8.12	60.41	91.63	7.78
	L	7.51	8.28	62.18	90.70	7.90
M1	R	10.97	10.65	116.83	103.00	10.81
	L	10.96	10.69	117.16	102.53	10.83
M2	R	10.91	10.35	112.92	105.41	10.63
	L	10.87	10.31	112.07	105.43	10.59
M3	R	11.03	10.96	120.89	100.64	11.00
	L	11.14	10.89	121.31	102.30	11.02

methodology (Moorrees, 1957a, b; Wolpoff, 1971).

The masticatory area available on the molars (*i.e.* Molar Crown Area, MCA) of the S. Pappinayakkanpatti individual is 683.41 mm^2. The value is calculated as the sum of cross-sectional area of the crowns of upper and lower molar teeth on one side of the dental arcade. It may he mentioned that the dental size is directly proportional to the type of food consumed and food preparation techniques employed. Mesolithic populations which had hunting-gathering life style have larger teeth than the farming communities who primarily consumed well processed food rich in carbohydrate. The molar size of the S. Pappinayakkanpatti individual is less than that of the Mesolithic Langhnaj (756.01), Bellan Bandi Palassa (702.46) and Bagor (695.10) or Chalcolithic Daimabad (726.23) or Neolithic Mehrgarh (697.74). The dental size of the present individual is more or less similar to that of the Megalithic population of Mahurjhari (675.54) (Walimbe and Kulkarni, 1993).

DESCRIPTION OF POST-CRANIAL ELEMENTS

The post-cranial elements are moderately built. Humerus exhibits septal aperture bilaterally. Radial tuberosity is quite pronounced. The femur is extremely robust with a prominent greater trochanter and linea aspera. Femoral head has a deep *fovea capitis*. The left femoral shaft is weathered and post-mortem deformity is evident. The tibiae have very sharp anterior edge. Squatting facet is seen on the distal end of the left side bone. Such additional articular area, to accommodate talus bone while squatting, is commonly seen in protohistoric populations as well as modern primitive groups and this feature is related to the prevalence of squatting habits, which probably indicates that the use of household furniture was not in vogue.

Table 4 gives metric data on post-cranial elements.

Table 4 : Osteometric data

Measurement	*Value*	
	Right	*Left*
Clavicle		
Maximum length	—	146
Circumference at middle of bone	—	37
Humerus		
Maximum length	335	—
Maximum mid-shaft diameter	19	20
Minimum mid-shaft diameter	15	15
Least circumference at mid-shaft	59	62
Ulna		
Maximum length	(272)	270
Physiological length	(255)	254
Maximum mid-shaft diameter	16	16
Minimum mid-shaft diameter	13	13
Least circumference at mid-shaft	45	46
Radius		
Maximum length	—	(250)
Maximum mid-shaft diameter	15	15
Minimum mid-shaft diameter	11	11
Least circumference at mid-shaft	40	40
Femur		
Maximum length	(470)	(470)
Anterio-posterior diameter at mid-shaft	32	32
Medio-lateral diameter at mid-shaft	28	27
Maximum diameter at head	43	42
Circumference at mid-shaft	44	44
Sub-trochanteric anterio-posterior diameter	32	32
Sub-trochanteric medio-lateral diameter	27	27
Tibia		
Maximum length	375	375
Anterio-posterior diameter at mid-shaft	31	30
Medio-lateral diameter at mid-shaft	22	22
Circumference at mid-shaft	80	(80)
Fibula		
Maximum length	(365)	—
Anterio-posterior diameter at mid-shaft	13	14
Medio-lateral diameter at mid-shaft	10	11
Circumference at mid-shaft	37	37

Completeness of some of the long bones facilitates the stature estimation for this individual. Trotter (1970) formulae suggested for White males have been used for the calculation of height. This individual is fairly tall with an average height of 173.13 cm. The bone-wise estimation of stature is given in table 5.

Table 5 : Stature estimation

Bone	*Side*	*Length (mm)*	*Stature (cm)*
Humerus	R	335	173.63 ± 4.05
Ulna	R	272	174.69 ± 4.32
	L	270	173.95 ± 4.32
Radius	L	250	173.51 ± 4.32
Femur	R	470	173.27 ± 3.27
	L	470	173.27 ± 3.27
Tibia	R	375	173.12 ± 3.37
	L	375	173.12 ± 3.37
Fibula	R	365	169.60 ± 3.39
Fem + Tib	R	845	173.14 ± 2.99
	L	845	173.14 ± 2.99
Average			173.13

AGE ESTIMATION

The individual is in 'difficult years' for age estimation. Epiphyseal fusion for all long bones was complete well before the death, meaning thereby that the individual was not younger than 25 years (Buikstra and Ubelaker, 1994). Heavy encrustation precludes precise comment on the progress of cranial suture closure. However, it appears that the coronal and sagittal sutures are closed. The progress of sagittal suture closure normally commences at around 20 years and terminates by 30 years of age. Most of the coronal suture is completely closed at 32 years (Stewart, 1979), suggesting an age of above 32 years for this individual. Molar teeth, including the third molar, are heavily worn, suggesting 'middle-age group' of this individual. Though precise age at the time of death cannot be estimated, a rough age bracket of 30 to 40 years can be suggested.

SEX DETERMINATION

The individual represented is of male sex as the sciatic notch is deep and narrow. The robustness exhibited in many of the features also suggests the same. Robusticity of neurocranial bones is evident in larger mastoids, prominent glabellar and nuchal regions and deep glenoid fossa. Mandible is strongly built with a gonial angle of 120 . The pelvic features like deep acetabulum, thick iliac crest and robust ischial tuberosity, and also the deltoid region of humerus, linea aspera and trochanter of femur and anterior crest of tibia are prominent, indicating maleness.

COMMENTS

Since only one individual is available for investigation, no conclusions can be drawn about the phenotypic affinities of the Iron Age inhabitants of S.Pappinayakkanpatti. However, it might be noted that this specimen resembles in some respects and differs in others, from the male population reported from the Iron Age site of Adittanallur, which lies about 150 km southeast of this site (Chatterjee and Gupta, 1963). The Adittanallur specimens are characterized by very long to moderately long crania, low and vertical forehead, high vault, prominent supraorbital region, rectangular orbit, mesorhinae or medium nose with a depression at the root and marked alveolar prognathism. The S. Pappinayakkanpatti specimen is almost equally long (180 mm, range quoted for Adittanallur is 195 to 171 mm with a mean value of 185.86 mm), but the breadth dimensions of this skull are in higher ranges. The broadest skull of Adittanallur is 136 mm (mean 130.57 mm) whereas the specimen studied presently is 140 mm. Higher values of breadth are also manifested in frontal-, mastoid-, bi-auriculare- and bi-gonial breadth. The glabellar region is quite prominent in the present specimen, but the degree of alveolar prognathism is only slight. The nose is broad with a depression at the nasal root. Orbits are rectangular, but slightly longer.

This individual exhibits certain similarities with the Iron Age population of Kodumanal, situated approximately 300 km northwest of the site under discussion, studied by the first author (in prep). In the robusticity expression and cranio-facial morphology, it resembles the Kodumanal male. It may also be noted that yet another male specimen form Kodumanal (Reddy and Reddy, 1987) has much broader crania (index 75.84) than the Adittanallur male specimens.

The degree of biological homogeneity of the peninsular Iron Age (Megalithic) population cannot be evaluated with certainty at this stage. Anthropological data, which is often fragmentary in nature and limited in number, in isolation will not be able to provide a complete answer to this problem. However, it might be able to provide a clearer picture, if supplemented by archaeological data.

The Megalithic burial practice involves the erection of various types of monuments for the dead. The burial types normally vary region to region. The availability of raw material is an important factor for such variations (Leshnik, 1974). For instance, in the deltaic regions of Thanjavur and Tirunelveli where rocks are not available, urns are the common mode of burials. However, the availability of raw material might not have always been the sole determinant factor. In Madurai region while urn burials with cairn-circle appendage are predominant, cist burials and menhirs also found in limited number. It is evident that there is a preference for a specific type, though the raw materials suitable for the erection of other types are also available. In such cases intra-cultural (ethnic?) differences might have played a significant role in determining the burial type. Situation becomes more confusing, if cultural differences are equated with biological differences. The Iron Age people of Adittanallur and Kodumanal are not much different biologically. However, at Adittanallur urn burials were used for disposing their dead, while at Kodumanal cist monuments were erected for the same purpose. The adult specimen recovered from the urn burial from S.Pappinayakkanpatti resembles more with the cist specimens from Kodumanal, rather than the Adittanallur ones which are from urns. With the meager amount of data available at hand, we are not in a position to evaluate the differences, both cultural and biological, existed among the populations of Kodumanal, Adittanallur and S. Pappinayakkanpatti. It appears that some kind of cultural differences, which may not be discernible in biological remains, must have existed within the Iron Age population.

The individual under discussion is robust. Robustness is related to the degree of mechanical stress on the body. Generally, mobile hunter-gatherers are more robust and it can be interpreted as a biological response to their rigorous life style and it implies high mechanical stress. The settled agricultural populations are not as robust as hunter-gatherers due to relatively less mechanical stress as evidenced in Chalcolithic populations of the Deccan Plateau (Walimbe and Tavares, 1996). In addition to the life style, the type of food consumed (*i.e.* more intake of animal proteins in Mesolithic populations, as against the carbohydrate rich food of agricultural populations), is also an important factor in the expression of robusticity. The settled Iron Age populations having mixed economy (both agriculture and pastoralism) seem to have consumed more proteins in the form of milk and meat than the settled farmers. For example, the Mahurjhari population is more strongly built than the Inamgaon population which was primarily agrarian and relatively more sedentary. S.Pappinayakkanpatti population must have engaged in dry farming, pastoral activities and hunting gathering as well. Robusticity of this individual probably reflects his 'not so luxurious' life style and mixed food habits. The dental evidence such as, size of the molar teeth, which is less than that of the Mesolithic populations, the wear pattern associated with enamel chipping and caries infection also indicates mixed food economy of the population.

It is important to remember that a trauma generally represents extrinsic influences on the skeleton, resulting from varied factors. Dynamic stress fractures are the most common condition found in the skeletal record. The incidence and location of dynamic trauma are greatly influenced by life style, gender and age. Hunter-gatherer populations have a different pattern of traumatic condition than the sedentary farmers; women generally differ from men; and children, from adults.

The type of wound seen in this specimen is more frequent in metal using communities. This injury could have been caused by a sword or an axe or other similar sharp and flat metal weapon, most probably of iron. Iron weapons of numerous types and kinds have been reported from the Iron Age burial sites of this region which indicate the martial component of Iron Age folk (Leshnik, 1974). Though the possibility of an accident cannot be ruled out in this case, it is relevant to highlight the 'external' life of early historic population depicted in the *Sangam* literature (Singaravelu, 1966) which shows that inter-group rivalries were quite frequent during this period. The injury under discussion could have occurred due to such inter-group rivalries. Rivalries were initiated by lifting enemy's cattle, and a fight follows when the offended group defends its cattle. Those who lost their life in such fights and during other heroic deeds were honored by erecting memorial stones (Rajan, 1992).

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