

Establishing identity from the skeletal remains: in reference of Alum Bhag a martyr from 1857 Indian Freedom Struggle

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ABSTRACT

Introduction: We undertook the present study to analyze morphological features of a skull supposed to be that of Alum Bheg, a martyr from 1857 Indian Freedom Struggle (also called Sepoy Mutiny), using established methods to validate identity with regards to age and height as available in the note found with the skull (about 32 year and 5 feet 7½ inch).

Methods: Identification of sex of the skull was done based on established criteria. Analysis for closure of skull sutures (cranial and facial) and measurement of orbitomedial (OM) & maxillomedial (MM) facial anthropometric lines were undertaken to provide an estimated age against each examined suture as well as group of sutures through established scoring systems. Further, approximate height of individual was estimated from skull length using regression equations from a reference adult Indian male population.

Results: Established criteria confirmed that the skull was of a male individual and skull sutures and age related morphological changes in bones indicate that it belonged to an individual in age range 20 -50 years with an average of 30 years and approximate height between 5 feet 8.2 inch to 6 feet 1.3 inch.

Discussion: Based on our observations we suggest that the skull belonged to a male individual around 30 years of age and height 5 feet 8.2 inch to 6 feet 1 inch. The observed values are in approximation with that mentioned in the historical note and slight differences may be attributed either to gross reporting of original values or limitations of anthropometric analysis.

Key Words: Alum Bheg; Anthropometry; Identification; 1857 Sepoy Mutiny; Skull

INTRODUCTION

The 1857 Indian Freedom Struggle (also called Sepoy Mutiny) was a widespread albeit unsuccessful rebellion against the rule of British East India Company between 1857-58. The event began on 10th May 1857 in Meerut and later spread to Delhi, Agra, Kanpur, Lucknow and other parts of then undivided India. The rebellion posed a considerable threat to British authority in South Asia and thus was aggressively subdued eventually culminating with the defeat of the rebels in Gwalior on 20th June 1858.

During the course of the mutiny, violent skirmishes were reported from different parts of India, which at times speak volumes about the exceptional cruelty inflicted on both sides i.e. on British officers and civilians (including women and children) by the rebels and on the rebels and their supporters (sometimes entire villages) by the Britishers. One such intriguing incident has recently been reported by historian Kim A. Wagner, a senior lecturer in British Imperial History at Queen Mary University of London, in his recent book “The skull of Alum Bheg- The life and death of a rebel of 1857”.¹ In this text, Wagner has narrated the incidents related to Alum Bheg (or Alim Beg) who was a Havildar in 46th Regiment of Bengal Native Infantry and probably belonged to then United Province (modern day Uttar Pradesh). As reported by Wagner, on 9th July, 1857, Alum Bheg and his fellow sepoys declared a revolt against the imperial rule which led to killing of many from the British side. The incident took place somewhere near Sialkot (in modern day Pakistan) which was a part of North Indian heartland in those days. Alum Bheg was eventually arrested from Madhopur (a town in Indian part of Punjab) and was tried for war crimes in Sialkot. He was charged with murder and was blown up from the mouth of a canon. Alum Bheg’s tragic story surfaced more than a century later, courtesy an Irish captain Authur Robert George Costello.¹

Costello was a captain in 7th Dragoon Guards, which was dispatched to India after the revolt had erupted and shook the core of the British Colonial Empire. Costello was present at the execution of Alum Bheg and supposedly collected his skull as a war trophy (a prevalent practice in those times) and returned to London with the same. In accordance with the fate of historical relics, the skull of Alum Bheg changed hands and was discovered in 1963 in a store room of the Lord Clyde pub (named after Collin Thomson aka Lord Clyde a military commander who was instrumental in crushing the mutiny in north and northwest India) of London. The links with the

history of the Indian Mutiny is a testimony to the possibility that Costello or some other British soldier could have visited this Victorian-era pub and deposited the skull there. The historical facts about the skull were revealed from a handwritten note which was neatly folded and left in an orbit of the skull itself. Along with a brief description of his job as a soldier and the reasons of the execution, approximate age and height of Alum Bhag at the time of his execution were found mentioned in the note as 32 years and 5 feet and 7 ½ respectively (Fig.1).¹

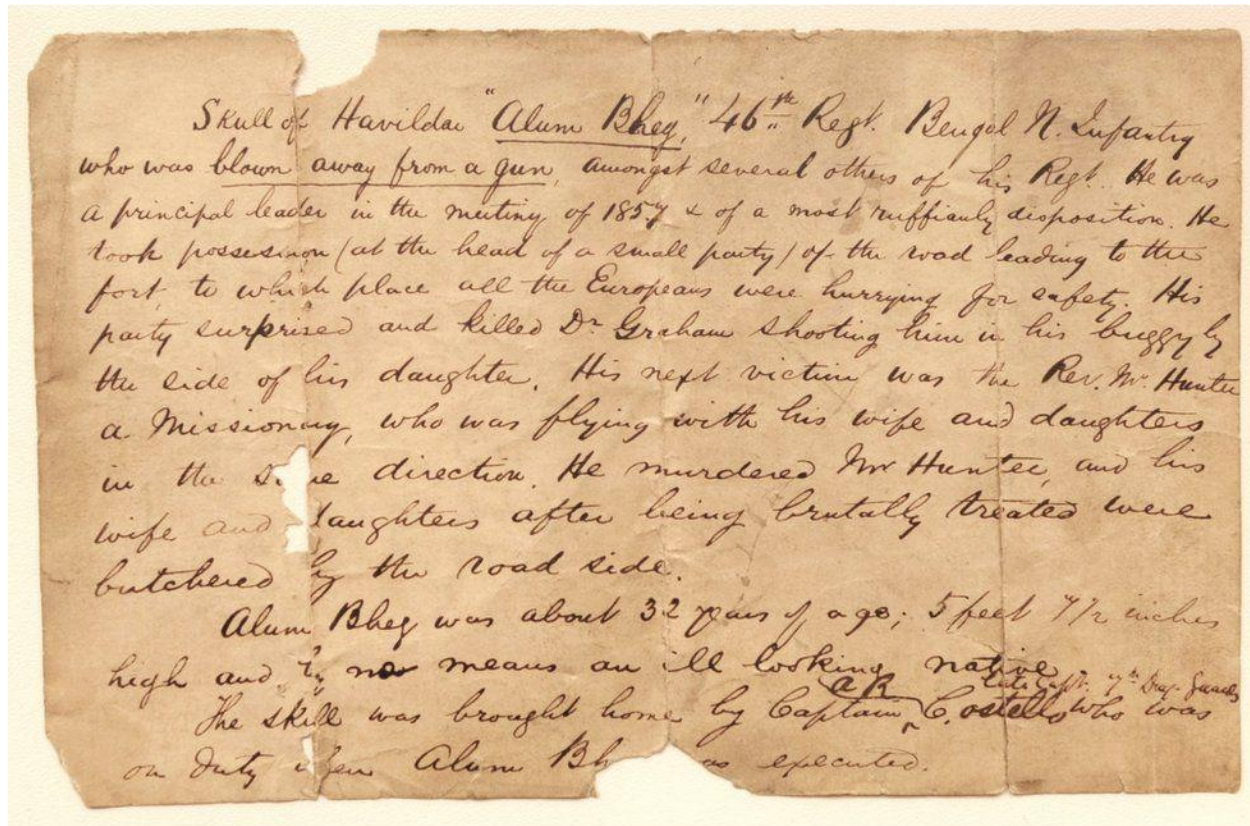


Figure 1 Photograph of the handwritten note which was neatly folded and left in an orbit of the skull itself and revealed the historical facts about the skull.

The skull is now in custody of the historian Kim Wagner who provided us the digital images and documented details necessary for this study. In our opinion, based on the available historical documents, this 160 year old human skull should be treated as a solemn object from the disturbing part of British history in the Indian subcontinent. Further the skull may be repatriated to the family members of the 'martyr', or deposited at a repository for British Imperial History to

avail optimum public recognition, to ensure a humane culmination of this dark episode from the past. To achieve this, it is necessary to establish the identity of the skull beyond reasonable doubt and hence we undertook this study to analyze the age related changes in the morphological features of this skull and performed anthropometric measurements using established methods in an attempt to validate the details available thereof in the documented literature.

MATERIALS & METHODS

The study was conducted in the Department of Anatomy of All India Institute of Medical Sciences, Patna. The study materials constituted the high resolution digital images of the skeletal remains (a human skull with left upper molar teeth but lower jaw missing), and details of the historical note found with the skull received from Department of British Imperial History at Queen Mary-University of London, claimed to be that of Alum Bheg and related authentic literature available on the Internet. The images from anterior, superior, lateral, posterior and inferior aspect of the skull were considered for the assessment.

Identification of the sex of the skull was done based on the established criteria (Table 1).² A meticulous analysis was undertaken of the closure of the skull sutures (cranial and facial), from the external surface visible in all the selected views after appropriate zooming of the images (Fig. 2). Further, the measurement of the orbitomedial (OM) and maxillomedial (MM) facial anthropometric lines (Fig. 3) on the anterior view image were performed. All image analyses were done using a digital image analyzer (Image J software from NIH). Buikstra and Ubelaker (1994) scoring system (Table 2)³ and Meindl And Lovejoy system (1985)⁴ (Table 2) were used to provide an estimated age against each examined suture and group of the sutures and the MM/OM length index was matched for the approximate age range of the skull (Table 3). Moreover, the anterior skull view was screened for presence of any age related changes in the facial bones as well as the teeth (Table 3), and the permanent molar teeth, spheno-occipital synchondrosis, and jugular growth plate (bilaterally) were evaluated against the standard age range mentioned in the literature (Table 3).

Further, from the length of the skull approximate stature of the individual (to which it could have belonged) was calculated using regression equations for stature of males derived from a reference study in the adult Indian male population (study represented only central Indian geographical region) (Estimated height: $122.32 + 2.63 \times \text{Head Length}$).⁵ As given in the reference study⁵ the length of the skull was considered extending from the glabella to a point on the maximum convexity of the occiput (opisthocranium) in lateral view of the skull (Fig.4). The sex, age and stature of the individual bearing this skull were matched with that mentioned in the note found with the skull (Fig.1).

Table 1 Sex determination in human skulls.

S. N.	Skull trait	Male	Female
1.	General size	Large (intracranial volume 200 cc. or more)	Smaller & lighter with thinner walls
2.	Architecture	Rugged	Smooth
3.	Glabella	Prominent	Less pronounced
4.	Orbits	Square, low placed, relatively small with rounded margins	Round, higher placed, relatively large with sharp margins
5.	Supraorbital ridges	Prominent	Less prominent
6.	Forehead	Sloping, less rounded	Vertical, full & infantile
7.	Fronto-nasal	Distinct angulation	Smoothly curved
8.	Cheek bones	Heavy, laterally arched	Lighter, compressed
9.	Zygomatic arch	Prominent	Less pronounced
10.	Frontal eminence	Small	Large
11.	Parietal eminence	Small	Large
12.	Occipital area: Muscle lines and external occipital protuberance	Well-defined	Not marked
13.	Mastoid process	Medium to large, round & blunt	Small to medium, smooth & pointed
14.	Base: Sites of muscle attachment	Well-marked	Less marked

15.	Digastric groove	Deep	Less deep
16.	Condylar facet	Long and slender	Shorter and broader
17.	Occipital condyles	Large	Small
18.	Palate	Large, broad & tends to be U shaped	Small, tends to be parabola shaped
19.	Frontal sinuses	Well-developed	Less developed
20.	Nasal aperture	High and narrow	Lower and broader
21.	Foramina	Large	Smaller
22.	Foramen magnum	Relatively large and long	Relatively small and round
23.	External auditory meatus: bony ridge along upper border	Prominent	Often absent
24.	Teeth	Large	Smaller

(Reference: Reddy KSN. Identification (Chapter 4). *In: The Essentials of Forensic Medicine and Toxicology*. 28th edition.

Reddy KSN (editor). Hyderabad: KS Devi, Medical Book Co.; 2009. p. 52-90.)

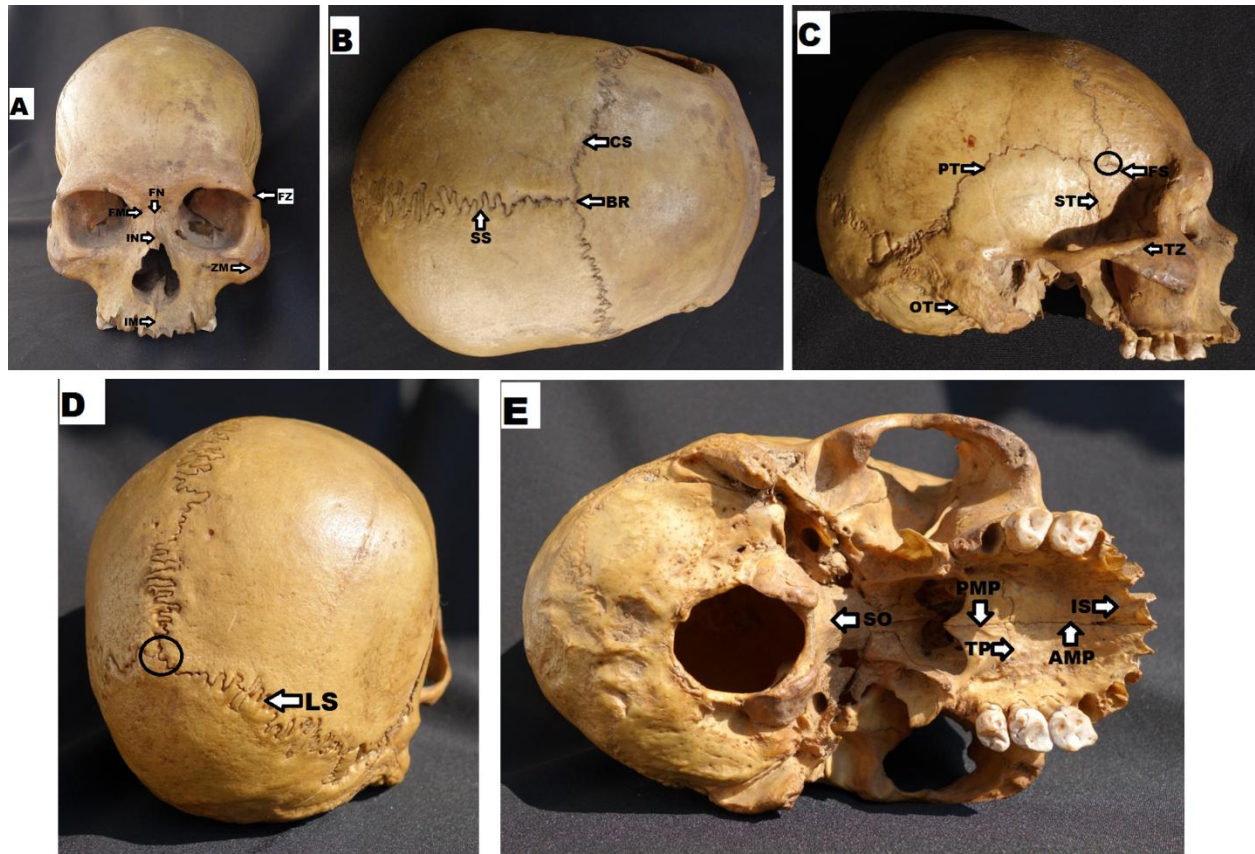


Figure 2 Composite photograph showing the facial and cranial sutures in different views of the skull under study. A. Anterior View [FZ – Fronto Zygomatic suture; ZM – Zygomatico Maxillary suture; IM- Inter Maxillary suture; IN- Inter Nasal Suture; FM- Fronto Maxillary Suture; FN – Fronto Nasal Suture]; B. Superior View [SS- Sagittal Suture; CS – Coronal Suture; BR – Bregma]; C. Lateral View [PT – Parieto Temporal Suture; ST – Spheno Temporal Suture; OT – Occipito Temporal Suture; TZ – Temporo Zygomatic Suture; FS: Fronto Sphenoidal Suture; Circle Marked Area – Terion] ; D. Posterior View [LS – Lambdoid Suture; Circle Marked Area- Lambda]; E. Lateral View [SO- Spheno Occipital Suture; AMP – Antero Median Parietal Suture; PMP – Postero Median Parietal Suture; TP – Transverse Parietal Suture; IS- Incisive Suture].

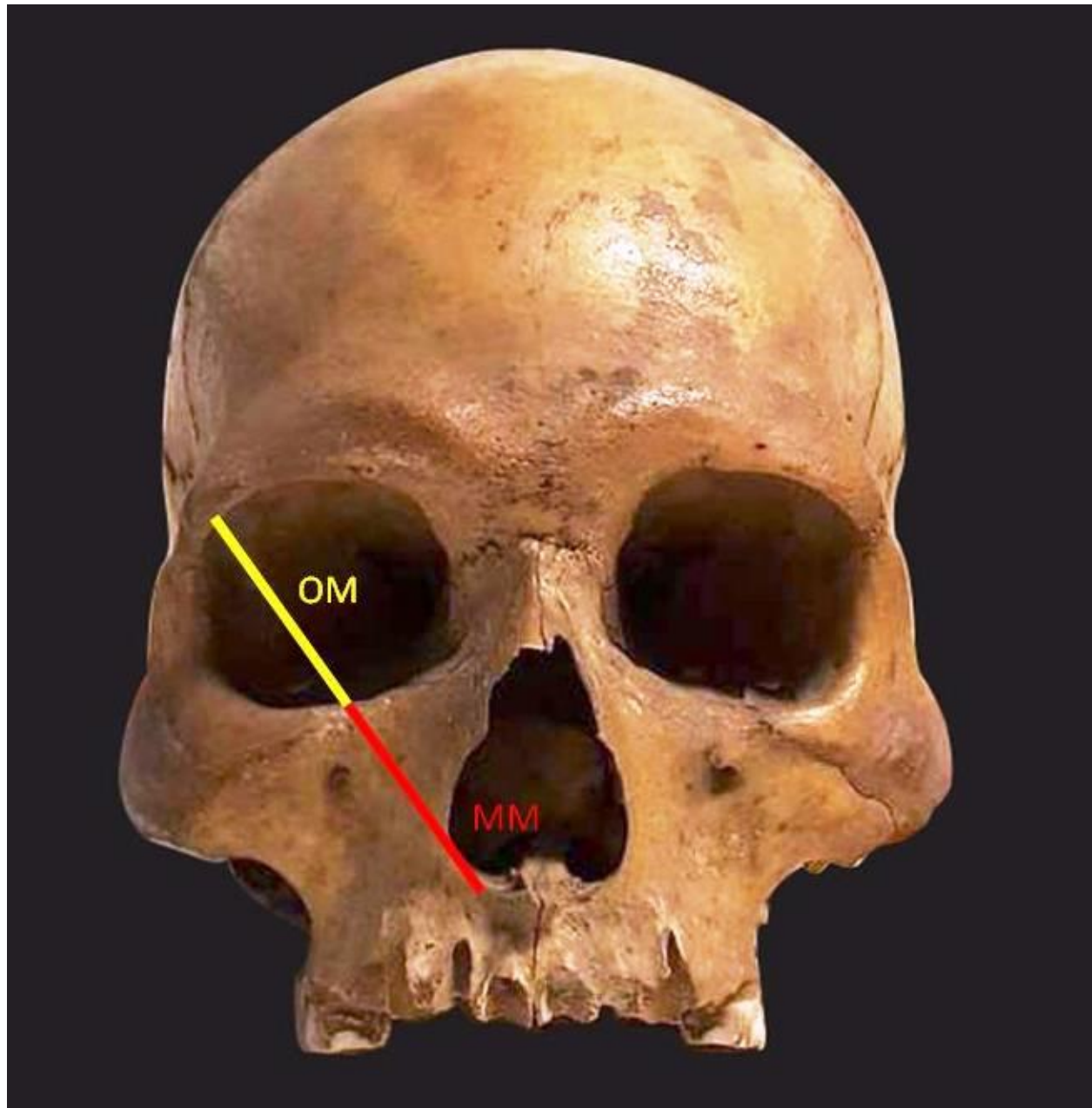


Figure 3 Anterior view of the skull under study showing the orientation of the orbitomedial (OM) and maxillomedial (MM) facial anthropometric lines.

Table 2 Determination of Mean Age of Skull from Established Scoring Systems.

Buikstra and Ubelaker scoring system, 1994		Cranial and facial sutures/points studied for chronological age estimation under Meindl And Lovejoy system, 1985		Anthropometric indexing of age changes in human skull		
Score Points	Degree of Closure	Serial No.	Name of suture/points (Vault group=1-7 Lateral Anterior group=6-10)	Composite Score	Mean Age	Standard Deviation
0	The suture is open, i.e. no evidence of ectocranial closure	1	Mid-lambdoid	Vault group (1-7)		
		2	Lambda	0	-	-
1	There is a minimal closure of the suture	3	Obelion	1-2	30.5	9.6
		4	Anterior Sagittal	3-6	34.7	7.8
2	Sutures with evidence of significant closure	5	Bregma	7-11	39.4	9.1
		6	Mid Coronal	12-15	45.2	12.6
3	Completely obliterated suture (complete fusion)	7	Pterion	16-18	48.8	10.5
		8	Sphenofrontal	19-20	51.5	12.6
		9	Inferior Sphenotemporal	Lateral Anterior group (6-10)		
		10	Superior Sphenotemporal	0	32	8.3
				2	36.2	6.2

				3-5	41.1	10
				6	43.4	10.7
				7-8	45.5	8.9
				9-10	51.9	12.5
				11-14	56.2	8.5

Table 3 Anthropometric Measurements Based on Age Related Changes in Human Skull.

Anthropometric indexing of age changes in human skull			Age related changes in skull components		Age of appearance of permanent molar teeth	
Age Range	MM/OM ratio reference (Male)	MM/OM ratio reference (Female)	Skull Component	Age Related Changes	Permanent Upper Molar Teeth	Age of Appearance (Year)
<20	0.75	0.78	Orbit	Floor of the orbit expands inferiorly and laterally, losing the round shape	1 st Molar	6-7
20-50	0.77	0.77	Maxilla	An anterior and inferior bone resorption leading retrusion of face	2 nd Molar	12-13
>50	0.66	0.71	Zygoma	Anterior resorption	3 rd Molar	17-21
			Mandible	Loses vertical projection and fragile		
			Teeth	Dental caries, attrition		



Figure 4 Estimation of Height of the Person from Length of Skull through digital image analyzer (Image J software from NIH).

RESULTS

Using the established criteria the skull under study appears to belong to a male sex. Analysis of the closure of the studied single and group of sutures in all the skull views gives an impression that skull belonged to an individual in age range 20 -40 years with an average of 30 years (Table 4 & 5).

The MM/OM ration for the reference skull came out to be 0.81 (Fig. 3) which puts the skull in age range 20-50 years (Table 3)

In observation for the presence of teeth, two molars in the right upper jaw and three molars were found in left upper jaw (Fig.3). Based on the study of literature, the estimated age for the appearance of the molar teeth, ossification of the spheno-occipital synchondrosis and jugular growth plate came out to be 17-21 year, 18-25 year, and 22-36 year respectively.

No significant age related changes were visible in any facial bone in the all the views analyzed. Age changes in the mandible couldn't be studied because it was not available with the skull. No dental caries or any age related changes were found in the molar teeth.

The approximate height of the individual to which skull belonged came to be 5 feet 10.8 inch (SE 2.57).

Table 4 Age estimation based on closure pattern of cranial and facial sutures.

Name of suture (cranial)	Buikstra and Ubelaker score	Start of fusion (yr)	Complete closure(yr)	Estimated age(yr)
Coronal	0 to 2 from right end to left end	25-30 th	40-60	30-40
Saggital	0 to 1 from posterior to anterior end	25-30 th	40-60	25-30
Lambdoid	0-1	25-30 th	40-60	25-30
Parieto-temporal	Right-1 Left-0 to2	25-30 th	40-60	30-40
Spheno-temporal	Right-0-1 Left-0-1	25-30 th	40-60	25-30
Fronto-sphenoidal	Right-0-1 Left-0-1	25-30 th	40-60	25-30
Spheno-	3	20-25	>20-25

occipital				
Occipito-temporal (Jugular growth plate)	3 (bilaterally)	25-30	>25-30
Name of suture (Facial)				
Fronto-zygomatic	0	40-45	May not fuse completely	<40-45
Fronto-maxillary	0	40-45	May not fuse completely	<40-45
Fronto-nasal	0	40-45	May not fuse completely	<40-45
Inter-nasal	0	40-45	May not fuse completely	<40-45
Inter-maxillary		30-35	May not fuse completely	<30-35
Zygomatico-maxillary	0	40-45	May not fuse completely	<40-45
Temporo-zygomatic	0	40-45	May not fuse completely	<40-45
Anterior median palatine	0	40-45	May not fuse completely	<40-45
Posterior median palatine	0	40-45	May not fuse completely	<40-45
Transverse palatine	0	40-45	May not fuse completely	<40-45
Incisive	0	40-45	May not fuse completely	<40-45

Table 5 Age estimation based on closure pattern of group of cranial and facial sutures.

S.N.	Name of suture	Buikstra and Ubelaker score	Composite scores vs. chronological age (Meindl And Lovejoy, 1985)
1.	Mid-lambdoid	1	<p>Vault group (1-7 sutures/points) Total score= 2 Estimated Age= 30.5 +- 9.6 years</p> <p>Lateral Anterior group (6-10 sutures/ points) Total score= 4 Estimated Age= 41.1 +- 10 years</p>
2.	Lambda	0	
3.	Obelion	0	
4.	Anterior sagittal	0	
5.	Bregma	0	
6.	Midcoronal	1	
7.	Pterion	0	
8.	Sphenofrontal	0	
9.	Inferior sphenotemporal	2	
10.	Superior sphenotemporal	1	

DISCUSSION

There is little information available on the personal details and biological relations of Alum Bhag making the confirmation of his identification extremely difficult. The non-availability of any known biological relatives for the advanced biological methods like DNA finger printing, and confirmed precision of the radio carbon (^{14}C) dating only for the skeletal remains of the recent origin⁶ present a limit on use of these advanced biological methods for identification in present case. In such situation studying the age related morphological changes in the skeletal remains and their correlation with available documented details, may be an acceptable method for establishing identity of the individual.⁷ Age estimation based on the analysis of the age related morphological changes in facial bones, and the closure of skull sutures have been established methods since long.^{3,8} The literature gives a clear indication for approximate age ranges for such morphological changes in the human skull. Although, chances of error in such estimation is said to be significant, analysis based on the data from multiple sutures and measurement ratio of the facial anthropometric lines may give a closer estimation of the biological age when corroborated with the other evidences as in any other skeletal remains. Estimation of the approximate stature of the individual from the skull dimensions and its match with the value stated in the 'note' found with the skull is to further strengthen the conclusion of this study.

In the present study, analysis of the sex of the skull based on the established criteria suggested it belonged to a male individual. The third permanent molar tooth present in the upper jaw of the skull gave a confirmation that individual was not younger than 17-20th year of age. Ratio of the facial anthropometric lines ($\text{MM}/\text{OM}=0.81$) gives an age range of 20-50 years.

A review of existing literature suggests the extreme variation in the age of suture closures in reference of geographical region and ethnicity of the individual. In general, the fusion of cranial sutures is said to start at 25-30th year of age and gets completed by 40-60th year or even later. The sutures between facial bones may start fusing in the middle adult age (40-60th year) only and may not fuse completely until last.^{9,10} In present study, visible signs of the initiation of the fusion but incomplete closure of the coronal, spheno-temporal, and parieto-temporal sutures give indication that skull belonged to an individual within an age range of 25th to 40th year, expectedly at the middle of the age range.

No indication of the fusion in any facial sutures (except of the minimal evidence of the closure observed in zygomatico-maxillary sutures bilaterally) further keeps the estimated age in the range of 30-40th year (Table 4). The complete non-closure of mid-palatine sutures gives an indication that skull may belong to a person below 35 year age.^{11,12} Contrastingly, the complete ossification of the spheno-occipital synchondrosis (18-25th year), and jugular growth plate bilaterally (22-36th year) (Table 4) also indicate that the skull belonged to a person of the post pubertal age.^{13,14} No signs of caries or any age related attrition on the teeth and in the facial bones is also a hint that the skull belonged to an individual in early adult age (20-40th years). The assessment of the approximate stature of the individual based on the length of the skull came out between 5 feet 8.2 inch to 6 feet 1.3 inch (against 5 feet 7.5 inch in the historical note). The observed difference of the calculated stature may be attributed to the possible geographical discrepancies in the region of the origin of the individual and that represented in the reference study. The observed values for the age and height are in approximation with that mentioned in the historical note and slight differences may be attributed either to the gross reporting of the original values or limitations of the anthropometric analysis for such estimations.

In conclusion, analysis of our data suggests the skull belonged to an individual of male sex, age range 20-40 year with an average 30 year, and height 5 feet 8.2 inch to 6 feet 1.3 inch. Considerable approximation of the data derived for the age, sex and stature of the individual from this study with that mentioned in the 'note', which also mentioned the name and few other details, provides veracity of the claim that skull may belong to Alum Bheg.

Lacunae and future considerations

The reference data representative of Indian male population for the closure of skull sutures was lacking in this study owing to the extreme paucity of the indexed studies in this regard. For determination of stature, reference data used in this study represented only central Indian geographical region (facing the extreme paucity of the population specific data), which could be a mismatch to the martyr's place of origin (although, little has been documented about that). A matched reference data for the age and stature could have provided more realistic estimate. Also including more skull dimension parameters as width and perimeter of the skull could further enrich the assessment.

DNA finger printing of tissue procured from the skeletal remains can be matched in the future with close biological relatives of the martyr for eventual validation of the identity of the claimed skeletal remains used in this study. However the task would be an extremely arduous one due to paucity of the information regarding family and place of origin of the martyr. Moreover one cannot overlook the possibility of population migration within the Indian subcontinent since the event of Sepoy Mutiny.

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