Excavations at Emeelt Tolgoi Site: The third Report on Joint Mongolian-Japanese Excavations in Outer Mongolia

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1. Introduction
In 2016-2017, Mongolian (the Mongolian Academy of Sciences) Japanese (Kyushu University) joint team had excavated the Emeelt-Tolgoi Site in the Bayangkhorin province and found six individuals of human skeletal remains at the Bronze Age. In this chapter, we report basic information based on the morphological traits of these human bones.

2. Methods
Aging and sexing were primarily judged on the basis of the standards arranged by Buikstra and Ubelaker (1994). In sexing, as far as the preservation condition of material permits, we used a dominant sexing method using bones such as a hip bone (Phenice, 1969) and followed the method in Nakahashi and Nagai (1986) for poorly preserved material. Adult age was estimated based on age-related changes of the morphology of pubic symphysis and auricular surfaces (Todd, 1920; Lovejoy et al., 1985) and followed cranial suture closure (Meindl and Lovejoy, 1985).

We primarily followed the measurement method of Martin (Baba, 1991). Cranial and limb measurements were done by K.O., aging and sexing by the both authors.

3. Basic information: preservation, sex, age, and observations
The states of preservation were very good in the both individuals of M40 and M44 while there were only pieces of fragile bones in the rest of individuals. Table 2 showed the cranial measurements of the both individuals of M40 and M44. Table 3 indicated the estimated height of the both individuals of M40 and M44.

Burial individual M18
Preservation: Only fragments of bone were recovered. The inter orbital area of frontal (B1) and the diaphysis of right clavicles (B2, B3) were found in the lower layer of burial pit while the diaphysis of left clavicle, the spine of right scapular, and the diaphysis of left femur were excavated from the upper layer (Fig. 75).
Sex: Superciliary arch was not well-developed, the circumference of femur was relatively small. The biological sex could be therefore female.
Age: The age at the death reached adult but could not be estimated in detail due to its poor preservation.

Burial individual M30
Preservation: Only pieces of bone were found. The following parts were confirmed: the piece of right parietal, the diaphyses of right femur and left fibula, the upper half of right patella, metatarsals and foot phalanges, and left calcaneus.
Sex: The biological sex was unknown due to its poor preservation.
Age: The age at the death reached adult but could not be estimated in detail due to its poor preservation.
Fig. 76 The Emeelt Tolgoi M40 individual.
Fig. 77 The Emeelt Tolgoi M44 individual.

- **77-a)** the whole skeletal body
- **77-b)** the front view of cranium
- **77-c)** the obliquely front view of cranium
- **77-d)** the side view of cranium
- **77-e)** the top view of cranium
Burial individual M40
Preservation: The preservation was very good. The most of part were recovered except for mandible, left scapula, parts of ribs, vertebrae, hand and foot (Fig. 76a-e).
Sex: The angles of subpubic area and the greater sciatic notch were relatively narrow. The biological sex was judged as male.
Age: The union did not yet finish between sternal end and diaphysis of clavicle. The condition of the auricular surface of os coxae was assigned to the first or second stage according to the standard of Lovejoy et al. (1985). These stages ranged the twenties.
Observations: A Schmorl node was present at the middle level of thoracic vertebra. A depression was observed at the body of the right maxillary, which could follow some facial fracture.
Estimated height: 171.0cm calculated based on the Pearson formula (Table 3).

Burial individual M44
Preservation: The preservation was very good. The following parts were missing: sternum, left radius, pubes, ischia, left patella, the parts of ribs, vertebrae, hand and foot (Fig. 77a-e).
Sex: The greater sciatic notch seemed to be relatively wide even though the part of it was not preserved. The biological sex was judged as possible female.
Age: The condition of the auricular surface of os coxae was assigned between the stages of sixth and eighth according to the standard of Lovejoy et al. (1985). These stages ranged from the latter half of forties to fifties.
Observations: The mild bone lipping was present along the edges of the right elbow and hip joint (Fig. 78). Wear extended to the lingual surface of maxillary anterior teeth (Fig. 79).
Estimated height: 154.3cm calculated based on the Pearson formula (Table 3).

Burial individual M49
Preservation: Only pieces of bone were found. The following parts were confirmed: the vertebral arches of the seventh cervical or the first thoracic, the first and the second lumber, a hand phalange and a metatarsal (Fig. 80).
Sex: The biological sex was unknown due to its poor preservation.
Age: The age at the death reached adult but could not be estimated in detail due to its poor preservation.
Fig. 81 The Emeelt Tolgoi M82 individual.

Fig. 82 The distribution of factor 1 and factor 5 based on the principal component analysis using 18 items of cranial measurements.

Fig. 83 The distribution of factor 2 and factor 4 based on the principal component analysis using 18 items of cranial measurements.

Fig. 84 The distribution of factor 3 and factor 4 based on the principal component analysis using 18 items of cranial measurements.
Table 3 Height (mm) estimated based on the maximum length of femur.

<table>
<thead>
<tr>
<th>Sex</th>
<th>M40</th>
<th>M44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>477</td>
<td>419</td>
</tr>
<tr>
<td>Female?</td>
<td>1709.8</td>
<td>1543.4</td>
</tr>
<tr>
<td>Height (Stevenson)</td>
<td>1780.0</td>
<td>-</td>
</tr>
<tr>
<td>Height (Fujii)</td>
<td>1728.1</td>
<td>1554.7</td>
</tr>
</tbody>
</table>

The names in parentheses show the formula used for estimated height (Hiramoto, 1981).
Burial individual M82
Preservation: Only pieces of bone were found. The following parts were confirmed: the left scapular spine and the diaphysis of the lower limb bone (femur or tibia) (Fig. 81).
Sex: The biological sex was unknown due to its poor preservation.
Age: The age at the death probably reached adult but could not be estimated in detail due to its poor preservation.

4. Morphological analysis on the M40 cranium

Morphological analysis was done on the crania of the M40 young adult male, which was well-preserved. The following comparative materials were used as male individuals of the Bronze Age or early dynastic periods: Khyar Kharach, Tevsh, Delger-Khaan, Chandman, Egiin-Gol2015, Khushuut1, Khushuut2 in Mongolia (Okazaki et al., 2016, Okazaki and Yonemoto, 2017); Tuchengzi, Youyao, Nanerhai, Sanguan, Pinanbao in the northern Great Wall region; Xinghong, Zhouzhuang in the Central Plains (Nakahashi, 2014, unpublished data); Liangwangcheng, Laohushan, Wangtuanzhuang, Taowan, Huchang, Luying in the Yangtze Delta region (Nakahashi et al., 2002); Kashahu in the Chuanxi plateau of Sichuan (Nakahashi et al., 2013).

A principal component analysis was done using 18 items of cranial measurements. Table 4 indicated the factor loadings. Factor 1 had relatively high loadings in orbital breadth, frontal chord, and bizygomatic breadth, which could be interpreted as a vector to broad face. Factor 2 had relatively high loadings in basal length, facial profile length, and maximum cranial length, which could be interpreted as a vector to long head. Factor 3 had relatively high loadings in nasal height and upper facial height, which could be interpreted as a vector to high face. Factor 4 had relatively high loadings in frontal subtense and simotic subtense, which could be interpreted as a vector to three-dimensional upper face. Factor 5 had relatively high loadings in zygomatic chord subtense and basi-bregmatic height, which could be interpreted as a vector to prognaathism and high head.

Figure 82 showed the distribution of factor 1 and factor 5. All Mongolian individuals were located on the right lower quarter of the figure. It meant that the Mongolian of the Bronze Age generally had broad face and less prognathism and high head. The Emeelt Tolgoi M40 had the broadest face among the comparative materials. Figure 83 showed the

Table 4 The loadings of each factors by the principal component analysis using 18 items of cranial measurements.

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Maximum cranial length</td>
<td>0.13</td>
<td>0.72</td>
<td>0.29</td>
<td>0.14</td>
<td>-0.16</td>
</tr>
<tr>
<td>5. Basal length</td>
<td>0.09</td>
<td>0.84</td>
<td>0.08</td>
<td>0.17</td>
<td>0.30</td>
</tr>
<tr>
<td>8. Maximum cranial breadth</td>
<td>0.53</td>
<td>0.03</td>
<td>0.37</td>
<td>-0.24</td>
<td>-0.22</td>
</tr>
<tr>
<td>9. Minimum frontal breadth</td>
<td>0.56</td>
<td>0.40</td>
<td>-0.05</td>
<td>0.17</td>
<td>0.04</td>
</tr>
<tr>
<td>17. Basi-bregmatic height</td>
<td>0.03</td>
<td>0.47</td>
<td>-0.12</td>
<td>-0.12</td>
<td>0.64</td>
</tr>
<tr>
<td>40. Facial profile length</td>
<td>0.14</td>
<td>0.81</td>
<td>0.11</td>
<td>-0.04</td>
<td>0.11</td>
</tr>
<tr>
<td>45. Bizygomatic breadth</td>
<td>0.69</td>
<td>0.06</td>
<td>0.45</td>
<td>-0.26</td>
<td>0.00</td>
</tr>
<tr>
<td>48. Upper facial height (sd)</td>
<td>0.05</td>
<td>0.23</td>
<td>0.88</td>
<td>-0.01</td>
<td>0.14</td>
</tr>
<tr>
<td>51. Orbital breadth</td>
<td>0.82</td>
<td>0.22</td>
<td>0.13</td>
<td>0.12</td>
<td>-0.08</td>
</tr>
<tr>
<td>52. Orbital height</td>
<td>0.37</td>
<td>0.03</td>
<td>0.49</td>
<td>0.38</td>
<td>-0.05</td>
</tr>
<tr>
<td>54. Nasal breadth</td>
<td>0.64</td>
<td>-0.10</td>
<td>0.06</td>
<td>0.08</td>
<td>0.23</td>
</tr>
<tr>
<td>55. Nasal height</td>
<td>0.20</td>
<td>0.12</td>
<td>0.89</td>
<td>0.14</td>
<td>0.01</td>
</tr>
<tr>
<td>FC. Frontal chord</td>
<td>0.80</td>
<td>0.28</td>
<td>0.06</td>
<td>0.16</td>
<td>0.10</td>
</tr>
<tr>
<td>FS. Frontal subtense</td>
<td>0.15</td>
<td>0.20</td>
<td>-0.17</td>
<td>0.75</td>
<td>0.21</td>
</tr>
<tr>
<td>SC. Simotic chord</td>
<td>-0.19</td>
<td>-0.08</td>
<td>0.21</td>
<td>0.56</td>
<td>0.41</td>
</tr>
<tr>
<td>SS. Simotic subtense</td>
<td>0.14</td>
<td>0.08</td>
<td>0.25</td>
<td>0.70</td>
<td>-0.22</td>
</tr>
<tr>
<td>ZC. Zygomatic chord</td>
<td>0.49</td>
<td>-0.07</td>
<td>0.27</td>
<td>-0.42</td>
<td>0.47</td>
</tr>
<tr>
<td>ZS. Zygomatic subtense</td>
<td>0.10</td>
<td>0.08</td>
<td>0.07</td>
<td>0.15</td>
<td>0.76</td>
</tr>
</tbody>
</table>

The varimax method was used. The loadings that exceed 0.6 are in bold face.
distribution of factor 2 and factor 4. The Mongolian individuals widely varied regarding to the both vectors of long head and three-dimensional upper face. The Emeelt Tolgoi M40 had longer head and average three-dimensional upper face. Figure 84 showed the distribution of factor 3 and factor 4. The Mongolian individuals widely varied regarding to the vector of high face. The Emeelt-Tolgoi M40 had higher face among the comparative materials. Figure 85 showed the distribution of simotic chord and simotic subtense. The Emeelt Tolgoi M40 had relatively large simotic subtense and small simotic chord. As a result, the simotic index (77.0%) was the second highest among the comparative materials.

5. Summary

The biological sex and age were following: adult female for M18, adult and unknown sex for M30, young adult male for M40, middle adult female for M44, adult and unknown sex for M49, and adult and unknown sex for M82. Schmorl node and healed facial fracture was present for M40. Mild bone lipping was present on the right elbow and right hip joint, and extra-masticatory wear on maxillary anterior teeth for M44. The M40 cranium were characterized as broader and higher face, longer head, and three-dimensional root of nasal bone among the comparative materials.