TOOTH REMOVAL DURING RITUAL TOOTH ABLATION IN THE JOMON PERIOD

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ABSTRACT

The presence or absence of broken roots and root fragments in the alveolus resulting from ritual tooth ablation in Jomon skulls was investigated. Five out of 49 Jomon skulls with tooth ablation had residual tooth roots. These examples suggest that incomplete removal of the tooth sometimes occurred during ritual ablation. From this it can be speculated that Jomon people used the traumatic method to knock out teeth during ritual tooth ablation.

In Japan, ritual tooth ablation has been noted in skulls from the Jomon to the protohistoric Kofun period (Watanabe 1966; Harunari 1973, 1986; Ikeda 1981; Doi and Tanaka 1988, Takenaka *et al.* 1993). This custom was most actively practiced during the Late to Final Jomon. At major Jomon shell midden sites such as Satohama (Matsumoto 1920), Inariyama (Okura 1939), Yoshigo (Kiyono and Kintaka 1929; Nakayama 1952) and Tsukumo (Miyamoto 1925), the frequency of ritual tooth ablation by individual was 80-100%. Although many studies have focused on the subject of tooth ablation in prehistoric Japan the method(s) by which the teeth were actually removed have rarely been discussed.

Prehistoric skulls with broken roots or root fragments are thought to be related to ritual tooth ablation. There are many instances of residual tooth roots resulting from ritual tooth ablation in prehistoric Hawaii, and it is considered that the early Hawaiians knocked out teeth using stones or pieces of wood (Chappel 1927; Shima and Suzuki 1968; Pietrusewsky and Douglas 1993). Until now, however, the only Jomon skull with a broken tooth root resulting from ritual ablation was reported by Matsumoto (1929). Ikeda (1981) pointed out that Jomon people might have used an extractive rather than a traumatic method of tooth removal because of the few reports of residual tooth roots. He also stated, however, that the presence or absence of residual tooth roots should be reconfirmed before reaching more definite conclusions.

In this present paper, therefore, we re-examine the residual tooth roots resulting from intentional tooth ablation in Jomon skulls and then use this examination to discuss the methods by which teeth were removed during ritual tooth ablation in the Jomon period.

MATERIALS AND METHODS

The sites and skeletal populations from the Jomon period used in this study are shown in Figure 1 and Table 1. Forty-nine skulls (25 males and 24 females) displaying ritual ablation of teeth were examined by the authors. All of the skulls are housed in the Laboratory of Physical Anthropology, Kyoto University.

The teeth anterior to the first premolars were the most frequently targeted for the removal in Jomon skeletal series. In the present study, broken roots and root fragments in the alveolus between these teeth were examined macroscopically. Broken roots and root fragments which were not

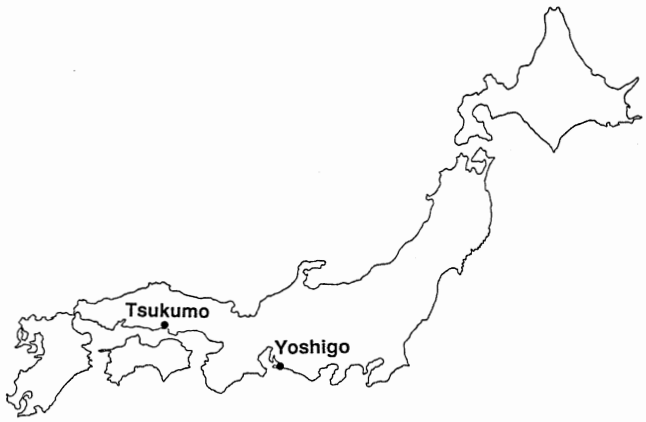

Figure 1: Location of archaeological sites.

carious, retained deciduous roots or odontoma were diagnosed as residual tooth roots resulting from ritual ablation. The significance of the frequencies of the residual tooth roots was tested using Fisher's exact probability test (Two-side test).

RESULTS AND DISCUSSION

There were five Jomon skulls having broken roots and/or root fragments in the alveolus resulting from ritual tooth ablation (Table 2 and Figures 2-6). All of the five were male. The frequency of residual tooth roots by individual observed in each of skeletal series is given in Table 3. The overall frequency of residual tooth roots, using two Jomon series, is greater in males (20.0%) than in females (0.0%) (Table 3). This result may indicate that the removal of male teeth is more difficult than that of female teeth. However, the difference in the frequency of residual tooth roots in males and females is not statistically significant at the 5% level ($p=0.0502$).

In the Jomon period, most teeth targeted for ritual ablation were visible teeth, such as incisors, canines and first premolars. The removal of these teeth is relatively easy, because most of them have single roots. In modern dental treatment, however, it is well known that the incomplete extraction of teeth can occur because of root hypertrophy, dilaceration, root ankylosis, or the presence of long, multiple or strongly furcated roots (Ishikawa 1979). The methods used in ritual tooth ablation can be conveniently divided into two. One is the traumatic method where teeth are knocked out by use of a stone or a piece of wood; the other is the extractive method which involves the pulling or prying out of the teeth by use of a piece of a cord or some sort of forceps-like instrument. Whatever the method employed, the most important part of the ablation procedure is the complete luxation of the tooth. Accidents such as broken roots and root fragments will not occur in tooth removal if the luxation of the tooth is complete. The traumatic method needs much stronger force to remove the tooth in a single blow than does the extractive method. Therefore, it can easily be imagined that the incomplete removal of teeth occurs regularly if the traumatic method is used in tooth ablation.

In this study, we confirmed five instances of residual tooth roots resulting from ritual tooth ablation out of a sample of 49 Jomon skulls (sexes combined). It is noteworthy that Jomon skulls displaying the ritual ablation of teeth had residual roots in 10.2% of cases. These examples, therefore, support the suggestion that incomplete removals sometimes happened in Jomon ritual tooth ablation and this is consistent with the hypothesis that Jomon people used the traumatic method to remove teeth during the ritual tooth ablation procedure.

The size of the broken roots and root fragments ranged from 2-12 mm in length (Figures 2-6). The residual tooth roots of Skeletons No. 24 and No. 32 at Tsukumo and Skeletons No. 396 and No. 538 at Yoshigo were small fragments of root apex. All of these fragments came up to the surface of the alveolus (Figures 3-6). Shima and Suzuki (1968) reported that root apex fragments were more numerous than broken roots in the residual tooth roots of early Hawaiians. They also observed that root apex fragments rose to the surface of the alveolus. The present study confirms their observations with respect to the movement of the remaining root apex fragments. Thus, it is considered that accidental breakages at the time of ritual tooth ablation are apt to occur in the root apex. Furthermore, it is also suggested that root apex fragments move up to the surface of the alveolus during the recovery of the damaged alveolar bone.

Table 1. Information on the materials observed in this study

Sites	Prefecture	Stages of Jomon Period	Sample Size		
			Total	Male	Female
Tsukumo	Okayama	Final*	27	13	14
Yoshigo	Aichi	Final*	22	12	10
Total			49	25	24

Table 2. Jomon skeleton having residual tooth roots resulting from ritual tooth ablation

Skeleton	Sex	Age	Site of residual Tooth roots
No. 19 at Tskumo	M	Young adult	2
No. 24 at Tskumo	M	Young adult	1
No. 32 at Tskumo	M	Mature	3
No. 396 at Yoshigo	M	Young adult	2
No. 538 at Yoshigo	M	Mature	2 1 1 2

Table 3. Frequency of residual tooth roots by individual in Jomon skulls with ritual tooth ablation

Site	Male		Female		Total	
	n/N	%	n/N	%	n/N	%
Tsukomo	3/13	23.1	0/14	0.0	3/27	11.1
Yoshigo	2/12	16.7	0/10	0.0	2/22	9.1
Total	5/25	20.0	0/24	0.0	5/49	10.2

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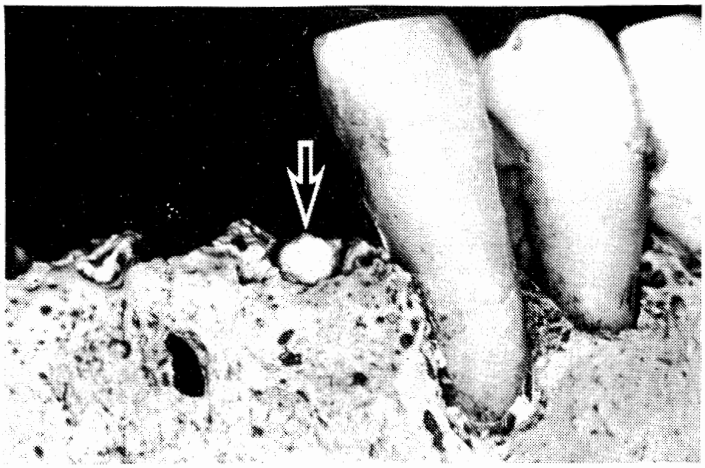

Figure 2: A broken root from Skeleton No. 19 excavated from the Tsukumo shell midden (Arrow: Lower left lateral incisor).

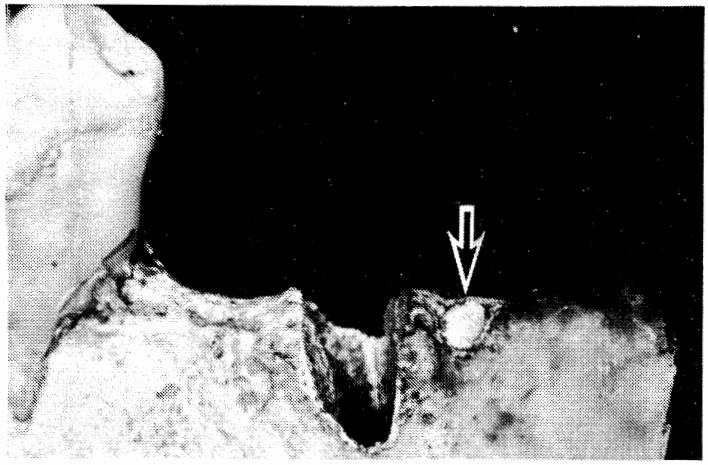

Figure 3: A root fragment of Jomon skeleton No. 24 excavated from Tsukumo shell midden (Arrow: Lower right central incisor).

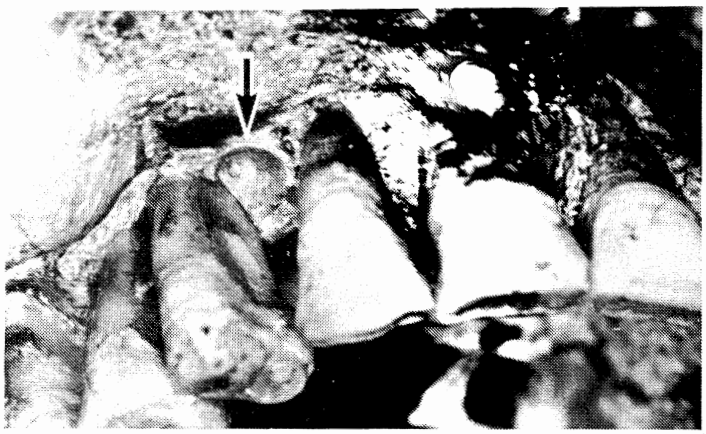

Figure 4: A socket of postmortem root fragment loss of No. 32 Jomon skeleton excavated from Tsukumo shell midden (Arrow: Upper right canine).

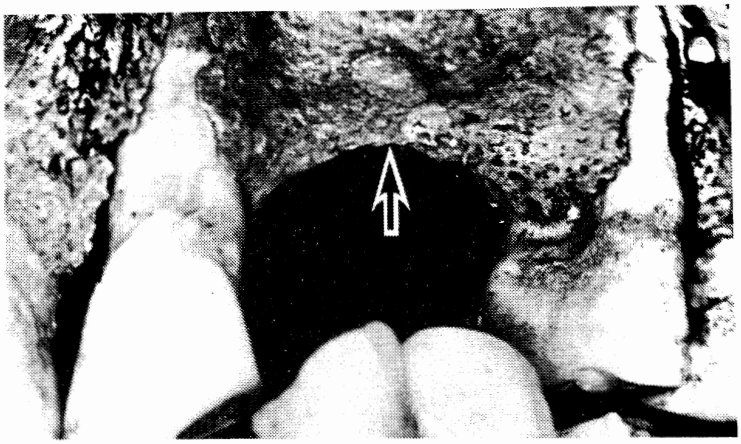

Figure 5: A root fragment of Jomon skeleton No. 396 excavated from Yoshiko shell midden (Arrow: Left upper lateral incisor).

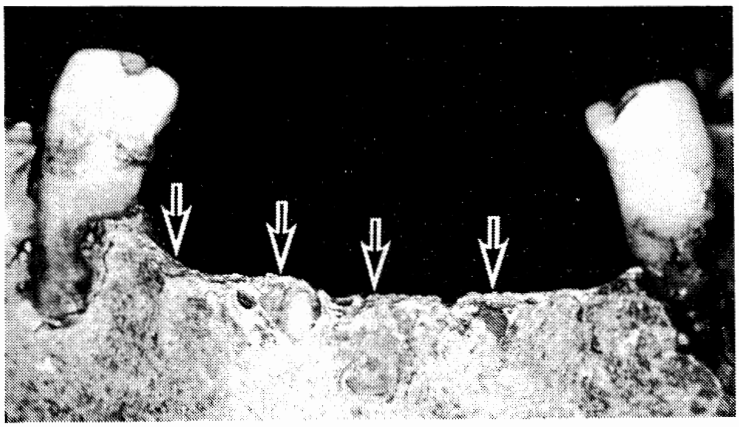

Figure 6: Four root fragments of Jomon skeleton No. 538 excavated from Yoshiko shell midden (Arrow: All four lower incisors).

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