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A CASE OF CONGENITAL ABSENCE OF THE LOWER SECOND PREMOLARS IN CATTLE AND A PHYLOGENETIC CONSIDERATION OF ITS ORIGIN*1

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A 7 year-old cow whose lower second premolar was absent on both sides of the jaw was examined. In order to establish whether its absence was congenital or of some other cause, such as caries, examinations were carried out and discussions were held. It was established that this was a case of congenital absence. This is of interest in connexion with the orthogenetic reduction of the cheek teeth on the ruminantia.

INTRODUCTION

The ruminantia have evolved as large cursorial herbivorous mammals; their limbs became elongated and their digestive system became complicated. A complex stomach and herbivorous teeth developed. The lower canines took on the aspect of the incisors, and the molars developed into a typical selenodont pattern. On the other hand, the upper incisors are reduced in and the upper canines are frequently absent.

All living ruminantia lack the first premolars, but there is no information to the writer's knowledge regarding the congenital absence of the second premolars in wild or domestic cattle.

In this paper, a case of cattle in which the lower second premolars are congenitally absent is reported with the aim of initiating morphological examinations and discussion, and the case is discussed regarding in its origin a tendency related to orthogenetic reduction of the ruminantia premolars.

MATERIAL AND METHOD

The case of the absence of the lower second premolars was found in one of the skeletal specimens for student practice in the Department of Veterinary Anatomy of

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Hokkaido University. This cow, Protocol Number 5350, is of the Holstein breed at the Hokkaido University farm, 7 years and 7 months old, and 530 kg in body weight. She was used for anatomical practice by students on May 9, 1970. No special pathological findings of all organs were found macroscopically.

For the purpose of investigating the partial anodontia or loss of another cause, this case was examined macroscopically, radiographically and microscopically. The sections for the microscopical examination were obtained from the interalveolar border on the left half of the mandible, where the alveolus of the second premolar is normally found. They are situated between the alveolus of the third premolar and the interalveolar border; one is a longitudinal section of 3 cm long, another is ten sheets of cross sections at intervals of 2.5 mm. These sections were ground to translucency on a fine carborundum and alminium oxide stone with a grinding machine, and were observed by means of polarizing microscope. This case of absence was contrasted with three mandibles of the cow Prot. No. 4445, 6 years old, a normal case; Prot. No. 1053, 15 years old, which lost three teeth (right P2, M1 & M2) through caries; and Prot. No. 4116, about 7 years old (according to the horn rings), which lost five teeth (left P2, P3, P4, M1 & right M1) through the same cause. Those samples were examined in the same way, and the sections from the reconstructive process of the alveolus which root lost and the normal interalveolar border near the second premolars were obtained.

In addition manual examination of the lower second premolars of three cows was done for the purpose of discovering hereditary relationship. The cows at the Hokkaido University farm have blood-relationship with the cow with the missing lower second premolars, namely, they are her two daughters and granddaughter, but they all have different fathers.

OBSERVATIONS

Figures 1 and 3 show the absence of the lower second premolars in the cow concerned. Macroscopically, all teeth appeared normal in size and shape, except for the absence of the second premolars. Furthermore there were no indications of concrescence of fusion with the lower second and third premolars. The interalveolar border near the lower third premolars in the abnormal specimen was as smooth as near the second premolars of a normal cow (fig. 1). Normally the occlusal surface of the upper second premolars are in contact with that of the lower second premolars and the anterior half of the lower third premolars. In this particular case, however, occlusal positions were contact between the upper second premolars and the anterior half of the lower third premolars only, but there were no anomalies in the occlusion of the teeth in this case (fig. 3).

Radiographically, the interalveolar border near the third premolars of the abnormal specimen was the same as near the second premolars of a normal cow (fig. 2). Here there is no sign of an impacted tooth, and no trabeculla apparent in the reconstructive process of a lost root in the alveolus.

Histological observations of the ground sections of the interalveolar border showed a regular longitudinal arrangement of the Harversian systems; and the alveolus of the reconstructive process showed an irregular arrangement of the Harversian systems. In the

abnormal specimen, the Harversian systems were regularly arranged at the interalveolar border where they corresponded to the alveolar position of the second premolar (fig. 4).

The lower second premolars of the three cows that had a blood-relationship with the abnormal specimen were normal.

Discussion

It is apparent from the data gained from the macroscopical, radiographical and microscopical observations that the lack of the lower second premolars in this case was congenital, and not caused by a caries.

The alveolus of the specimen with lost teeth, Prot. No. 1053, 15 years old, which have been progressed a reconstructive process, showed a tuberositas surface there in the macroscopic examination, trabecullae in the radiographic examination, and an irregular arrangement of Harversian systems in the microscopic examination. In a human example, the reconstructive process continues after the extraction of teeth[6]. In the meantime the thin trabecullae is shown by radiograph. This abnormal specimen would have lived only 5 years after loosing the teeth if the second premolars had falled out as soon as they had been cut. Nevertheless, in this specimen there is no evidence of the reconstructive process and no anomalies in occlusion as observed in the loss of teeth.

Yamakawa et al.[11] reported that the loss of teeth by cattle is almost never found in animals under 10 years old, but that 50 losses of teeth were found in 49 mandibles over 10 years old. A great proportion of the lost teeth were a fourth premolar and a third molar. The loss of a second premolar was found only in two left-side mandibles. In the abnormal cow, the fourth premolars and first molars are normal, but only the lower second premolars are absent on both sides.

No impacted teeth were discovered radiographically, and no fusion was discovered macroscopically.

Many cases of partial anodontia have been observed in conjunction with hereditary ectodermal dysplasia[5,10], but the abnormal cow appeared to have a normal skin, and there is no observable trace of ectodermal dysplasia.

Consequently this case, it is clear to be a congenital absence of the lower second premolars.

In man, it is considered that partial anodontia is connected with a gradual decrease in the size of the jaw. Fujita[1,2] states that the decrease of mammalian teeth can be found to separate three parts, namely, incisor, canine and molar, the decrease is shown from distal in the upper incisors, from medial in the lower incisors and from distal in the upper and lower molars. Almost all examples of partial anodontia in man agree with this law, and it is not always hereditary.

He named this "the phylogenic decrease theory", and he said that partial anodontia shows the future type of dentition in man.

There are numerous reports about bovine teeth, but no reports about partial anodontia. In ruminantia, the selenodont developed in the lower third molars, and the premolars do not usually show the full molar pattern but remain comparatively simple in shape. Furthermore, the first premolars are absent in all living ruminantia, and some species of *Bovidae*, such as *Pantholops* and *Saiga*[4], often lack the second premolars. In other words, in ruminantia, the reduction of cheek teeth may occur in medial portion with their advance. It is significant that the abnormal specimen discussed conforms with the orthogenetic direction of the cheek teeth in ruminantia.

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Explanation of plate

Fig. 1 The lower cheek teeth showing anodontia of the second premolars
All teeth were normal except for the absence of the second premolars. And there is no tuberositas near the third premolars of the interalveolar border.

Fig. 2 Radiograph of the mandible of this abnormal specimen
There is no impacted tooth and no trabeculla in the interalveolar border near the third premolar.

Fig. 3 Occlusion in this specimen
Occlusal positions were contact between the upper second premolars and the anterior half of the lower third premolars only, but there were no anomalies in the occlusion of the teeth as can be observed in the case of the loss of teeth.

Fig. 4 Cross section of the interalveolar border of the left mandible
The section is 5 mm from the alveolus of the third premolar; here is the alveolar position of the second premolar in normal case. The Harversian systems are regularly arranged. × 17


P.5350
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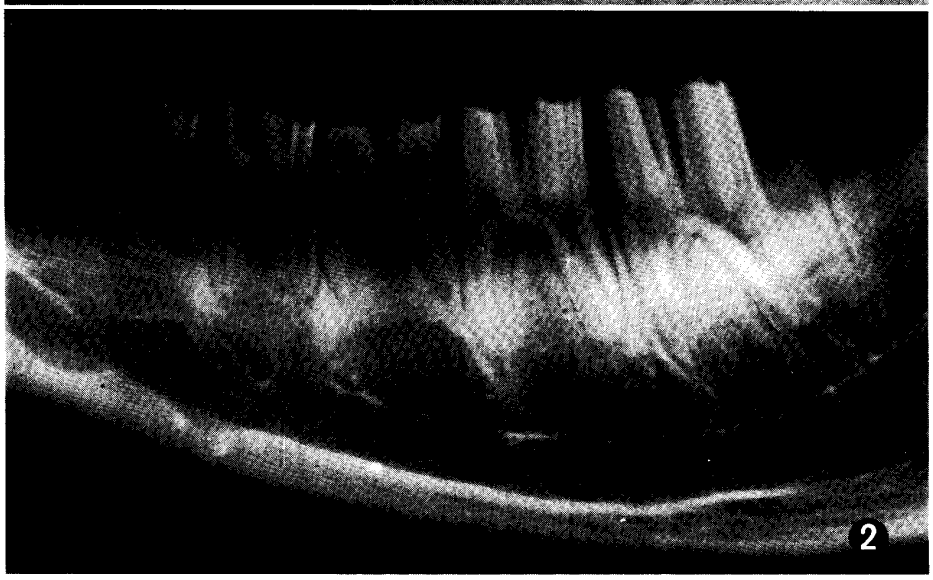
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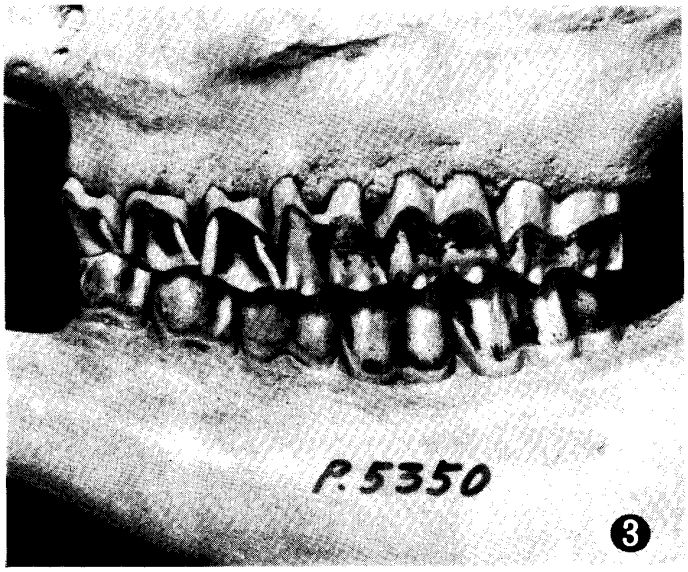
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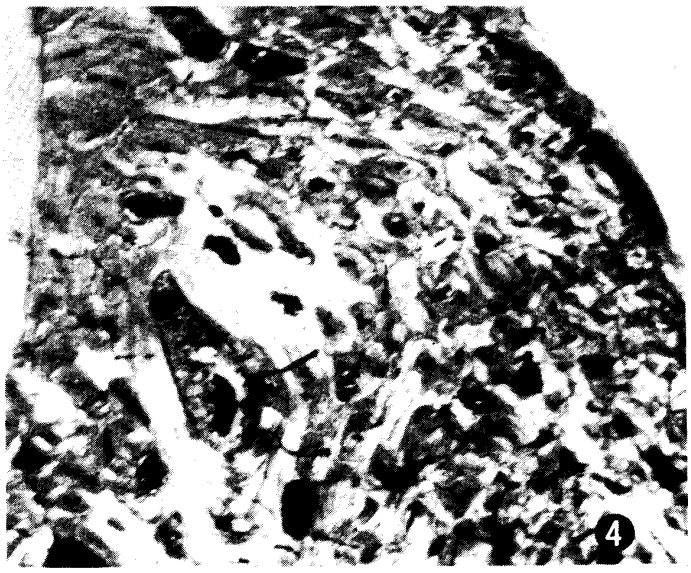
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