

Tooth Wear of Two Male Giraffes (*Giraffa camelopardalis*) in Winter Season

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ABSTRACT

Two male reticulated giraffes (*Giraffa camelopardalis reticulata*), 21-year-old, died of nutritional deficiency that primarily caused by serious tooth wear at Seoul Zoo in winter. A 970 kg-weighted giraffe showed tooth wear of premolars, molars and incisors at necropsy. A foreign body in the rumen, congestion and ulcer of abomasum and duodenum were also observed. Mild appearance of serous fat atrophy in pericardial sac suggests that lack of nutritional intake caused by tooth wear can become harmful enough to threat life. At the necropsy of a 1,290 kg-weighted giraffe, a large quantity of sandy soil were found in the rumen which would stuck the pathway of well-fermented ruminal contents at esophageal groove. Nutritional deficiency could be suspected to urge this giraffe to graze grass on the ground along with sandy soil. Secondly, the soil damaged teeth and become a culprit making irregular tooth wear and mild serous fat atrophy. Nutritionally good care of geriatric animals is needed especially for browsing animals like giraffes and critically in winter season.

(Key words : giraffe, serous fat atrophy, soil, teeth, winter)

INTRODUCTION

In the process of mastication, teeth are critical to pulverize dry matter before swallowing it. Tooth wear caused by attrition and abrasion is often considered as a critical factor determining longevity of captive and free-ranging wildlife (Jurado *et al.*, 2008). Feeding zoo browsers on leaves all the time is not practical at modern zoos. Dental health is so directly connected with what they are fed that nutritional management has been cautiously applied to zoo browsers though mostly part of their feeding is composed of same as grazers (Robinson, 1979; Archer and Sanson, 2002; Clauss *et al.*, 2007). At Seoul Zoo, reticulated giraffes (*Giraffa camelopardalis reticulata*) are usually fed alfalfa hay, pelleted feeds, grass hay, fruits, vegetables, and bread. Compared to grazers that have high-crowned (hypsodont) teeth, browsers like giraffes usually have low-crowned (brachydont) teeth (Robinson, 1979; Clauss *et al.*, 2003; Jurado *et al.*, 2008). Husbandry of browser animals in captivity is a real challenge to zoos in the world. Sudden deaths of giraffes in captivity have been known as serous fat atrophy and associated with serious dental problems (Portter and Clauss, 2005; Clauss *et al.*, 2007; Jurado *et al.*, 2008). In this study, how tooth wear effected on nutritional intake and related with longevity.

CASE REPORT

Two captive born male giraffes, 21 years old, weighed 970 kg and 1,290 kg, died in the winter of 2008~2009. At necropsy, serious teeth wear was commonly and clearly observed. Asymmetrical tooth wear were shown in both giraffes together with wire and sandy soil in rumens (Fig. 2, A and Fig. 3, A), abomasal congestion (Fig. 2, B and Fig. 3, C), and mild serous fat atrophy in cardiac tissues (Fig. 2, D and Fig. 3, D). Incisors and right premolars and molars were worn out and invaded up to pulp where nerve and blood vessels distributed (Fig. 1, C~F). This giraffe would rely only on the left side of premolars and molars to feed on hay. The first molar (M1) was missing (Fig. 1, B). The ruminal contents were not much in the rumen that is assumed to contribute to congestion and mild ulcers in the walls of abomasum and duodenum (Fig. 2, B and C). The heavier giraffe's teeth were less worn out than the other one but physically rough hay might damage the upper gum of left cheek (Fig. 3, E and F). Even though a lot of quantity of ruminal contents existed in the rumen, the abomasum was empty (Fig. 3, B and C). It means that sandy soil at the bottom of rumen might function as a plug to obstruct the flow of well-fermented ruminal contents into omasum and abomasum (Fig. 3, A~C).

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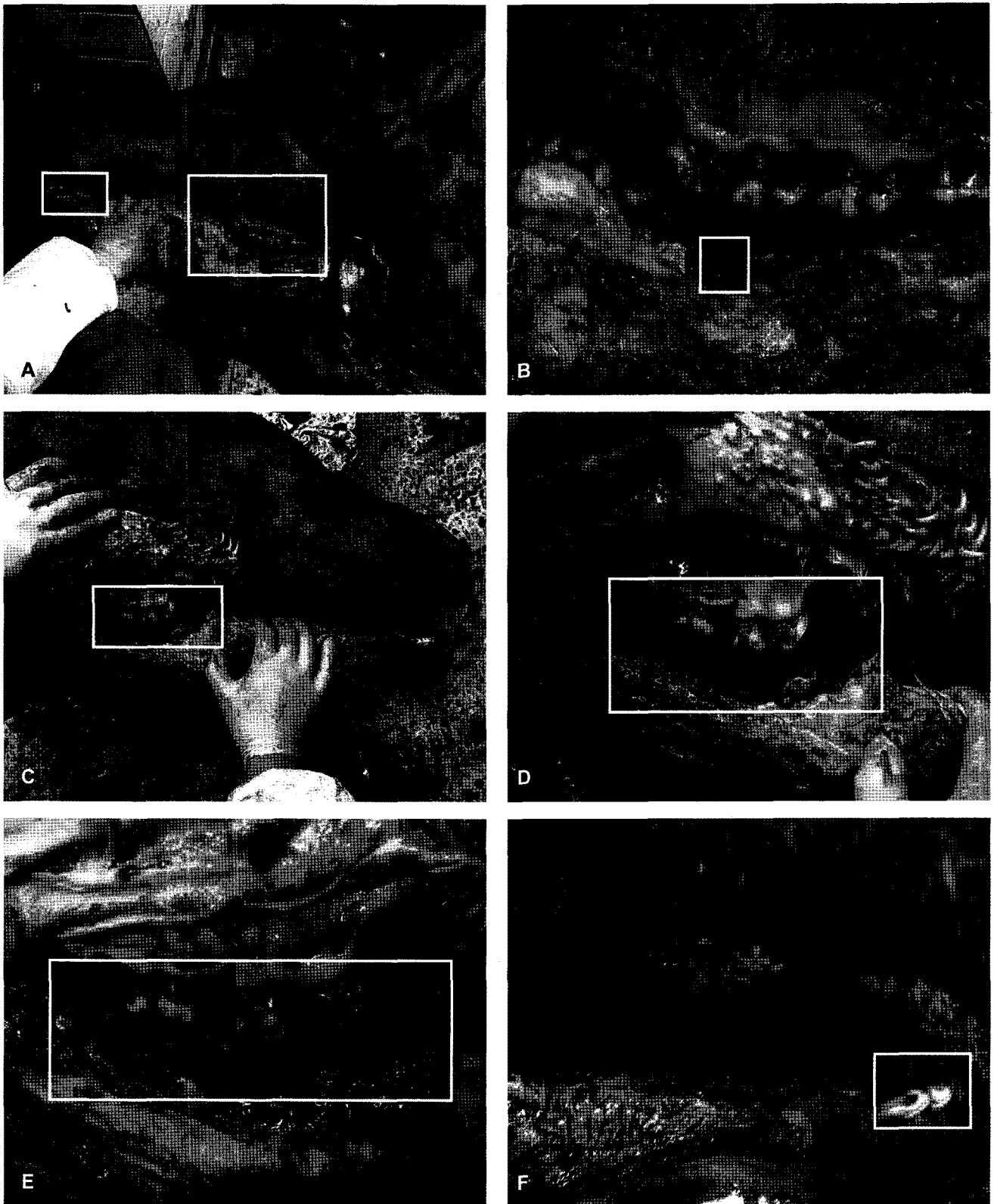


Fig. 1. Tooth wear of a male, 21-year-old and 970 kg-weighted giraffe. (A) Incisors (small box) and left cheek teeth (large box) were shown. (B) The first molar was missing. (C-E) The premolars and molars of right cheek were irregularly worn out. (F) Incisors and canine teeth were also seriously ground.

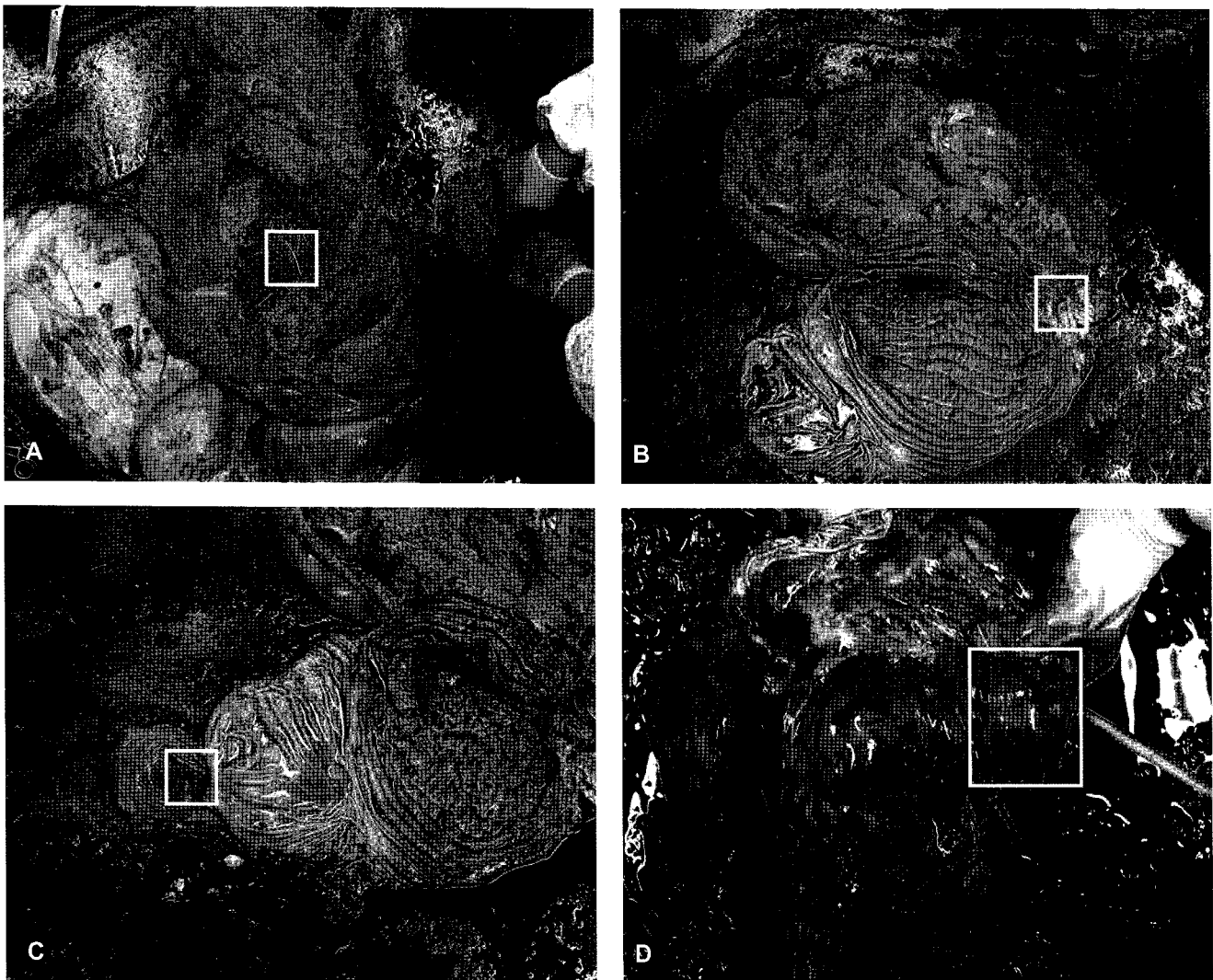


Fig. 2. Digestive and cardiac disorders of a male, 21-year-old and 970 kg-weighted giraffe. (A) In the rumen, a wire-like foreign body (box) was found. (B) The abomasum is surrounded by arrows and omasum is shown in the box. (C) The boundary (box) between duodenum and abomasum was congested. (D) Mild serous fat atrophy was shown in the pericardial sac (box).

DISCUSSION

Giraffe's dental formula is I 0/3, C 0/1, P 3/3, M 3/3, totally 32 teeth. The incisors are important at grabbing onto leaves and twigs and then pulling it into mouths using their long tongues before beginning to chew (Fig. 1, A and F). Canine teeth are also critical in the first step of feeding which are splayed out in two or three lobes to comb the leaves off shoots. The incisors and canine teeth of 970 kg-weighted giraffes were heavily worn out, by which the giraffe must have had difficulty at feeding that was proved by a small quantity of ruminal contents and lighter body weight compared to the other dead giraffe same aged (Fig. 2). Asymmetrical occlusion

is assumed to accelerate excessive wear of incisors and canine teeth which even stopped feeding on grass (Fig. 1). Progressive and asymmetrical tooth wear for a long time is thought to directly cause weight loss, weighed 970 kg much lower than an average of 21-year-old male giraffes. Free-ranging goats avoid grass forage if they have worn incisors (Mellado *et al.*, 2005). It means that a difference in diet selection depends on how worse the teeth are damaged and which teeth are worst worn out. In contrast to the 970 kg-weighted giraffe, 1,290 kg-weighted giraffe still had healthy incisors (not shown) enough to feed on grass on the ground though sandy soil fed on with grass caused serious abrasion of teeth (Fig. 3, A, E and F). Thus, tooth wear can influence diet choice and, if no choice

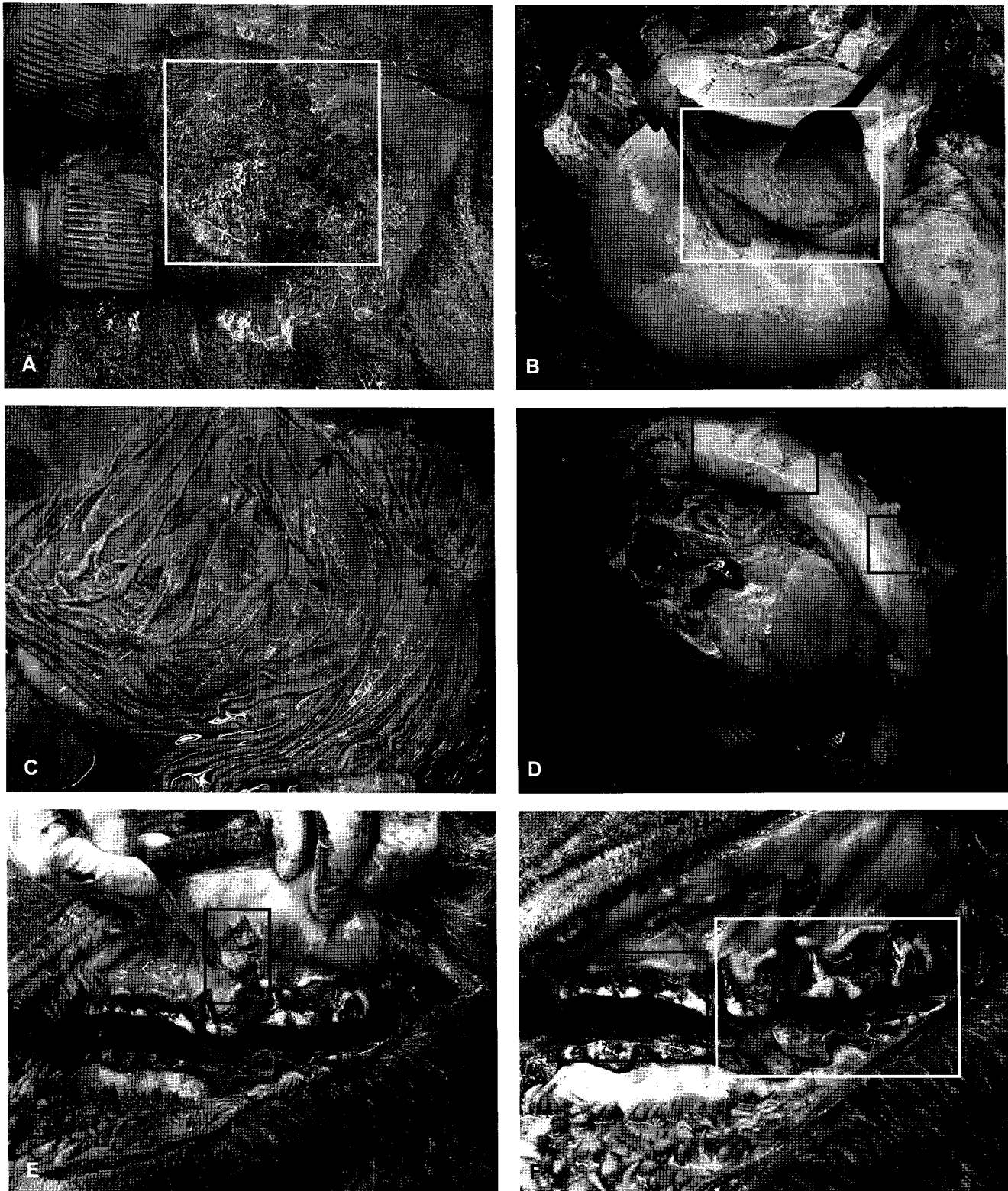


Fig. 3. Digestive, cardiac and dental abnormalities of a male, 21-year-old and 1,290 kg-weighted giraffe. (A) A lot of sandy soil (box) was found in the rumen. (B) Ruminal contents fermented well were shoveled out of the rumen. (C) The boundary between omasum and abomasum is indicated by arrows. (D) Mild serous fat atrophy (boxes) was seen on the coronary artery. (E and F) Physical damage in the gum (box) and irregular teeth (boxes) were shown.

is available in a captive setting, probably also the food intake level (Clauss *et al.*, 2003; Hummel *et al.*, 2008; Jurado *et al.*, 2008). Attrition and abrasion are the losses of tooth structure by mechanical forces from opposing teeth and a foreign element, respectively. Tooth wear of browsers is dominated by attrition whereas that of grazers is dominated by abrasion (Robinson, 1979; Foose, 1982; Jurado *et al.*, 2008). However two giraffes in this report clearly showed tooth wear pattern of grazers. The decreased intake was caused by tooth wear and two giraffes became nutritionally deficient showing mild serous fat atrophy (Fig. 2, D and Fig. 3, D). In non-ruminant animals, rumination-like behavior can occur because of tooth wear (Logan, 2001, 2003).

Serous fat atrophy is often related with irregular tooth wear in ruminants (Jurado *et al.*, 2008). It mainly affects thin animals and becomes primary causes of sudden deaths that have been predisposed undoubtedly by inadequate energy input (Clauss *et al.*, 2003; Potter and Clauss, 2005).

In the case of a 1290 kg giraffe, a lot of sand soil was found that means it had eaten grass on the soil of outer enclosure due to inadequate amount and quality of hays (Fig. 3, A and B). In addition, the sandy soil in the rumen existed near to esophageal groove obstructed normal stream of ruminal contents to omasum and abomasums (Fig. 3, A~C). Although grazer's teeth seem adapted to food ingested in captivity, browser's teeth seem less well suited to efficiently chew captive diets (Hummel *et al.*, 2008). Even grazer's teeth could get affected if they were fed on sandy soil (Mellado *et al.*, 2005; Jurado *et al.*, 2008). At least browsers must be fed from racks.

Stomatological treatments are needed to maintain good condition of zoo animal's teeth (Van Foreest and Roeters, 1997; Wenker *et al.*, 1998; Willis *et al.*, 1999; Wilman *et al.*, 1999). The first defense we can easily approach would be nutritional management that reduces mechanical loss of dental materials.

Free-ranging giraffes have much healthier teeth than ones in captivity (Clauss *et al.*, 2007). The primary reason of irregular tooth wear must be traced in this study to correct problematic husbandry and prevent the other giraffes from its longevity being shortened by same reasons.

Captive giraffes rarely reach their maximum life span of 26~30 years (MacClintock and Mochi, 1973). Two giraffes in this report had been taken care for 21 years, much longer than average longevity of 15 years in the wild, but the giraffes could have lived a little longer if the diets would become fitted with age and dental status (Baxter and Plowman, 2001).

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