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CASE REPORT

Concurrent Root Elongation and Atherosclerosis in a Rabbit Secondary to Dietary Imbalance: A Case Report

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Abstract

Dietary imbalance is a significant predisposing factor for metabolic and dental disorders in domestic rabbits. Diets enriched in cholesterol and deficient in indigestible fiber have been associated with vascular mineralization and acquired dental disease in domestic rabbits. A five-year-old male domestic rabbit (weighing approximately 3 kg) was presented to the Royal Veterinary Hospital with a two-week history of lethargy, anorexia and bilateral epiphora. Standard radiographic examinations were conducted. Skull radiography revealed elongation of the mandibular and maxillary cheek tooth roots with associated malocclusion and mandibular lysis. Thoracic radiographs demonstrated marked mineralization of the thoracic aorta extending toward the abdominal cavity, consistent with vascular mineralization. The rabbit underwent dental trimming and extraction of the second mandibular premolar under isoflurane anesthesia. Postoperatively, dietary modification was recommended to the owner, emphasizing increased hay intake and reduced commercial pellet consumption. This case illustrates the concurrent occurrence of root elongation and aortic mineralization likely secondary to chronic dietary imbalance. Proper nutritional management based on high-fiber diets is essential to prevent both vascular and dental pathologies in domestic rabbits.

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Introduction

Atherosclerosis in rabbits is a chronic, progressive disease characterized by the accumulation of lipids, inflammatory cells, and fibrous elements in the arterial walls. It does not occur spontaneously in this species; rather, high plasma cholesterol concentrations—particularly low-density lipoprotein (LDL) cholesterol—induce atherosclerotic lesion formation, either due to high-cholesterol diets or artificial induction under laboratory conditions (1). Rabbits' sensitivity to high-cholesterol diets has made them valuable experimental models for studying atherosclerotic disease in humans (2). Under natural circumstances, a rabbit's diet primarily consists of high-fiber grasses and hay rich in indigestible carbohydrates, which provide the mechanical abrasion necessary for proper dental wear, rather than being defined merely by a low fat or cholesterol content (1). However, when the diet is artificially enriched with high levels of cholesterol (typically between 0.5% and 2%), rabbits develop pathological changes similar to those observed in human atherosclerosis. In such cases, serum cholesterol levels increase dramatically, leading to lipid deposition in the arterial walls, especially in the aorta (3).

A primary reason rabbits develop this condition more rapidly than humans is that their lack of certain enzymes required for efficient regulation of dietary cholesterol (4). They have a limited ability to control hepatic cholesterol synthesis, making even small amounts of added dietary cholesterol sufficient to significantly elevate plasma LDL levels and initiate the atherosclerotic process (5).

Clinically, atherosclerosis in rabbits rarely produces overt symptoms. However, in severe cases, nonspecific clinical signs such as weakness and reduced activity may be observed. In advanced cases, sudden death due to arterial occlusion or vital organ failure may occur (5).

Lesion severity is more dependent on the duration of exposure than on dietary dose, and plaque formation is significantly greater and more severe in older rabbits (5). Atherosclerotic lesions contain smooth muscle cells, macrophages, and lipids. Due to anatomical and hemodynamic factors, these lesions are more common in the abdominal aorta (6). Thrombosis is a common feature of atherosclerosis, and plaque rupture is a major cause of this complication, which leads to severe cardiovascular events such as stroke, unstable angina, and myocardial infarction (3). Radiographically, atherosclerosis is recognized by mineralization of the walls of various arteries and veins; however, the most common sites are the thoracic and abdominal aorta.

An appropriate nutritional regimen is also crucial for preventing dental disease in rabbits. A diet deficient in key components—particularly adequate fiber—contributes to a range of dental problems, including root elongation.

Root elongation is a significant and often under-recognized dental pathology in pet rabbits (*Oryctolagus cuniculus*) (7). Although rabbits possess aradicular hypsodont teeth that lack true anatomical roots, the term "root elongation" is widely used in the veterinary literature to describe excessive proliferation of the apical portion of the tooth extending beyond its normal anatomical boundaries. In the present report, the term "root elongation" is used to describe radiographic evidence of apical overgrowth and associated osseous remodeling.

This condition is particularly concerning in rabbits because of the close proximity of the teeth to vital anatomical structures such as the nasolacrimal duct, orbital cavity, and mandibular cortex (8). Deformity of the surrounding bone, displacement of adjacent structures, and secondary complications such as abscess formation or osteolytic changes have been described in association with root elongation.

Diagnosing this condition in its early stages can be challenging, particularly in the absence of routine imaging (8).

While root elongation may initially be a compensatory response to decreased occlusal forces, it ultimately represents a pathologic process resulting from the disruption of the finely tuned relationship between dental growth and wear (9). This condition is most frequently associated with a chronic dietary imbalance, particularly an insufficient intake of abrasive, fiber-rich forage.

A rabbit's diet must consist predominantly of fiber-rich hay and abrasive forage containing indigestible structural carbohydrates, which are essential for maintaining the balance between continuous tooth eruption and occlusal wear. However, when rabbits are fed excessive amounts of commercial pellets, the balance between tooth growth and attrition is disrupted, resulting in root elongation. Its occurrence underscores the complex interplay among anatomy, diet, biomechanics, and evolutionary biology in the health of domestic rabbits. Understanding the fundamental causes and anatomical implications of root elongation is necessary for both preventive action and informed clinical management, particularly given the increasing popularity of rabbits as companion animals and the growing recognition of their unique veterinary needs (10). Root elongation presents with nonspecific clinical signs; therefore, diagnostic imaging is essential for confirmation. Skull radiography may reveal varying degrees of root overgrowth; depending on severity, findings may include mandibular bone lysis, maxillary abscessation, and malocclusion.

Clinical History

A five-year-old male domestic rabbit (weighing approximately 3 kg) was presented to the Royal Veterinary Hospital with a two-week history of lethargy, anorexia, and bilateral epiphora. According to the owner, the rabbit had been maintained predominantly on commercial pelleted feed with limited access to hay and fibrous forage.

Physical examination revealed mild weight loss, dental malocclusion, and reduced body condition score. No overt cardiovascular abnormalities were detected on auscultation. Laterolateral and dorsoventral radiographic projections of the skull and thorax were obtained using a Fuji Prima T2 radiography system. On the laterolateral skull projection, elongation of the mandibular and maxillary cheek tooth roots was observed, along with periapical abscess formation, mandibular lysis, and overgrowth of the maxillary cheek teeth beyond the reference line. Malocclusion was also present (Figure 1A). On the laterolateral thoracic projection, the thoracic aorta appeared markedly mineralized (Figure 1B).

Advanced imaging with thoracic computed tomography (CT) was recommended to further characterize the extent and nature of the vascular changes; however, the procedure was declined by the owner due to financial limitations.

Hematologic and serum biochemical analyses, including measurement of serum cholesterol concentration, were also not performed for the same reason. Therefore, definitive confirmation of atherosclerosis was not possible, and the interpretation was based solely on radiographic findings.

Although vascular mineralization may result from multiple etiologies—including metastatic calcification secondary to renal dysfunction, hypervitaminosis D, or dystrophic mineralization—no clinical signs suggestive of systemic disease were identified during the physical examination. Considering the documented history of a prolonged pellet-dominant diet and the concurrent presence of root elongation consistent with chronic fiber deficiency, dietary imbalance was considered the most plausible contributing factor in this case.

Under isoflurane anesthesia, the patient underwent dental trimming procedures, and extraction of the second mandibular premolar was performed, along with correction of malocclusion. (Figure 2). The postoperative period was uneventful.

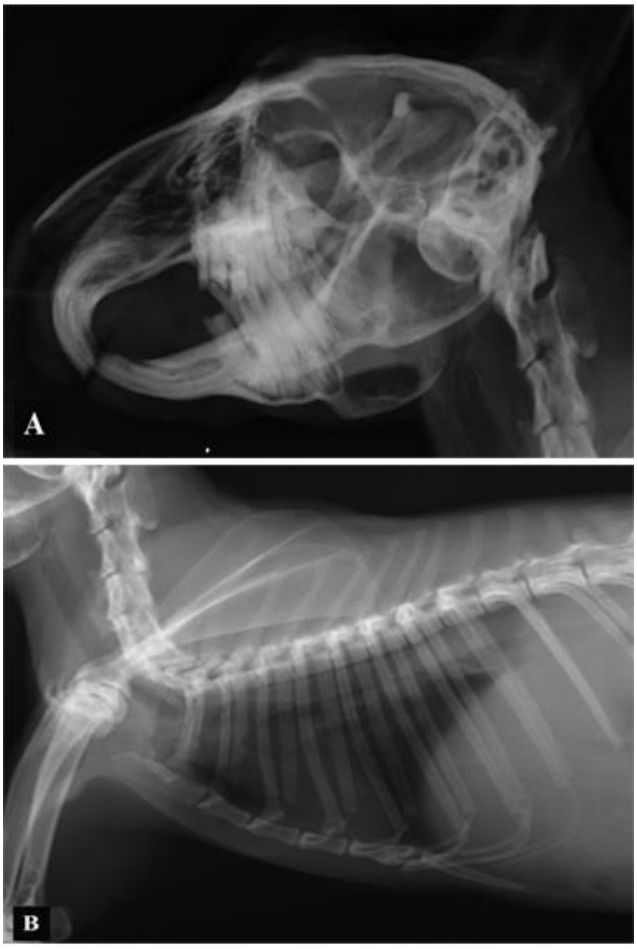

Figure 1: Radiographic findings in a rabbit. (A) Laterolateral view of the skull demonstrating malocclusion and root elongation of the cheek teeth. (B) Laterolateral thoracic projection showing mineralization of the thoracic aorta.

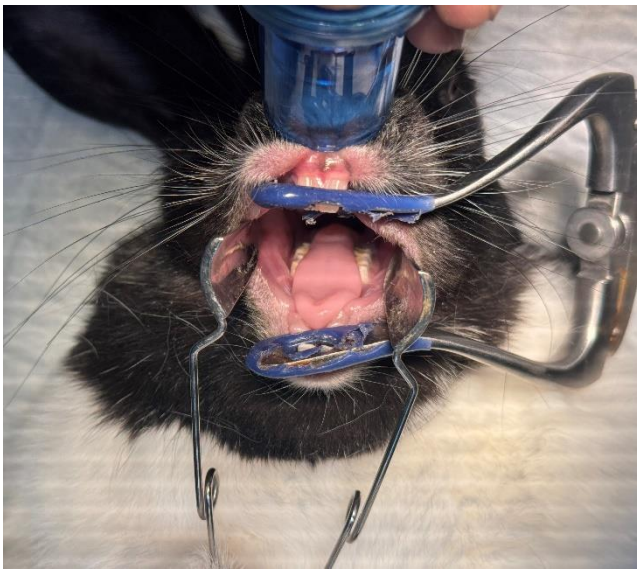

Figure 2: Clinical photograph of the rabbit's oral cavity after cheek teeth trimming, performed under anesthesia

The owner was advised to gradually transition the rabbit to a high-fiber, hay-based diet while reducing concentrate pellet intake. Recommendations also included routine dental monitoring and periodic imaging to assess potential progression or recurrence of both dental and vascular abnormalities.

Discussion

The principal reason for the development of atherosclerosis in rabbits is similar to that in humans: prolonged consumption of a cholesterol-rich diet increases plasma cholesterol levels, allowing LDL particles to infiltrate the endothelial layer (11). Within the intima, LDL particles undergo oxidative modification, resulting in the formation of oxidized LDL (11). This modified form is taken up by macrophages, forming foam cells, which constitute the initial core of atherosclerotic plaques. Over time, plaques enlarge, incorporating fibroblasts and smooth muscle cells, and form a fibrous cap that thickens the arterial wall and reduces its elasticity. In advanced stages, calcification, central necrosis of the plaque, and even plaque rupture may occur (6).

Sex-related susceptibility has been noted; female rabbits exhibit higher basal nitric oxide levels and improved vasodilatory responses due to circulating estradiol, rendering them less susceptible than males, as observed in the present case (12).

Cholesterol-rich diets are known to induce hypercholesterolemia and atherosclerotic plaque formation in rabbits; however, vascular mineralization is typically a multifactorial process that may also involve disturbances in calcium metabolism and progressive calcification of the vascular wall. Experimental studies in rabbits consistently demonstrate that cholesterol-rich diets induce aortic mineralization and plaque formation (13–14), a finding consistent with the radiographic observations in the present case.

Phinikaridou et al. (2009) administered a high-cholesterol diet to a rabbit over an eight-week period, an intervention that led to aortic mineralization, plaque development, and thrombus formation (15). The mineralization of the aorta observed in their research is consistent with the findings of the current study.

The continuous eruption of rabbit teeth requires constant occlusal wear provided by abrasive, fiber-rich forage. Failure to maintain this balance results in root elongation and associated complications (16-17).

In the study by Cheon-Sik Park et al. (2012), two different methods for treating root elongation in pet rabbits were evaluated. While nonvital pulp therapy was one option, the conservative method-which included pharmacological intervention and dental trimming-proved more effective (18). These results are consistent with the outcomes of the present study, highlighting the value of less invasive, conservative management in addressing dental overgrowth in rabbits.

In a study, Hamlin (2013) explored the role of regular dental trimming combined with dietary modifications as a preventive and therapeutic strategy for managing root elongation (19). The research emphasized that appropriate dietary adjustments could significantly reduce the incidence of dental overgrowth, particularly when accompanied by consistent trimming protocols (19). In a subsequent study in 2007, Frances Harcourt further investigated the effectiveness of trimming and, when deemed necessary, tooth extraction in addressing advanced cases of root elongation (20). Together, the findings of these two studies highlight the importance of early intervention and individualized treatment plans. These insights are particularly relevant to the therapeutic strategies employed in the current investigation, reinforcing the significance of integrative approaches in the clinical management of dental abnormalities.

The uniqueness of the present case lies in the concurrent radiographic detection of aortic mineralization and root elongation in a privately owned pet rabbit with a documented history of chronic pellet-dominant feeding. While experimental hypercholesterolemia-induced atherosclerosis is well described in laboratory rabbits, reports in companion rabbits under field conditions remain limited. This case highlights the potential systemic consequences of prolonged dietary imbalance in domestic settings.

Clinically, this case emphasizes the importance of early dietary counseling, routine dental imaging, and awareness of potential subclinical vascular changes in rabbits maintained on concentrate-heavy diets. Preventive husbandry practices centered on high-fiber, hay-based nutrition remain the cornerstone of long-term health management.

Conclusion

This case illustrates the concurrent occurrence of root elongation and aortic mineralization, likely secondary to a chronic dietary imbalance. Proper nutritional management based on a high-fiber diet is essential to prevent both vascular and dental pathologies in domestic rabbits. Excessive reliance on concentrate-based commercial pellets, particularly when fiber intake is inadequate, may increase the risk of metabolic and dental disorders,

potentially reducing lifespan. Atherosclerosis may result in sudden death without prior clinical signs, whereas root elongation can lead to anorexia and gradual systemic decline.

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Authors' Contributions

Milad Samadipoor: Conceptualization, Data curation, Validation, Writing – review & editing. **Pouran Mohammadi:** Conceptualization, Investigation, Review & editing. **Alireza Shahmir:** Surgical procedure, Review & editing. **Pedram Hozhabry Manesh:** Investigation, Writing original draft.

Data Availability

All data generated or analyzed during this study are included in this published article.

Ethical Approval

All animal procedures were conducted in accordance with the ethical guidelines for the use of animals in clinical practice.

Conflict of Interest

The authors declare that they have no conflict of interest.

Consent for Publication

Not applicable.

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