Unusual Congenital Development of Hoof- and Tail-Like Structure in the Buccal Mucosa of a Buffalo Calf: A Rare Case Report

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Abstract: A rare congenital anomaly was observed in a neonatal buffalo calf presenting with unusual tissue growth resembling hoof and tail-like structures within the oral mucosa. This case is the first of its kind reported in buffalo calves and contributes to the limited literature on oral anomalies in large animals. The buccal space's limited size and distribution of adipose tissue make it an anatomically significant location. Clinical and histopathological evaluations were conducted to characterize the nature of the growth because of the variety of tissues present. A unilateral (right side) buccal space tissue (horn and tail) growth and its surgical management, along with prognosis, are discussed in this report.

Keywords: Congenital anomalies, Hoof, Neonatal, Oralmucosa, Buccal space.

1. INTRODUCTION

Congenital anomalies associated with ectopic tissue development are uncommon in veterinary medicine, particularly within the oral cavity [1]. Their occurrence may be attributed to genetic influences, environmental factors, or an interplay of both; however, in many cases, the precise etiology remains unclear. Potential mechanisms include inherited mutations, teratogenic exposure during fetal development, or complex gene–environment interactions [2]. Reported environmental contributors to such anomalies comprise nutritional deficiencies, teratogenic drugs or chemicals, viral infections, ingestion of toxic plants, exposure to radiation, and per-rectal examination during the early stages of organogenesis [3]. Despite these recognized factors, the underlying causes of numerous congenital defects remain unidentified [4]. Developmental abnormalities are most likely to arise during the 4–8-week period of fetal growth [3]. Among the anatomical regions of significance, the buccal space is often referred to as the 'overlooked space' due to its relatively small size and the presence of limited adipose tissue, known as the buccal fat pad [5]. Because of these features, conditions affecting this region are easily missed or underestimated. Moreover, the diverse range of tissues present within and surrounding the buccal space can give rise to unilateral swellings that pose a diagnostic challenge. Hence, clinicians need to remain vigilant and consider the spectrum of possible disorders that may present in this area [6].

Congenital malformations of genetic origin pose a significant limitation to both selective breeding strategies and animal welfare, particularly when the causative gene mutations remain unidentified and carriers cannot be detected until the mutation becomes widespread enough to manifest phenotypically [1].Although breeding programs are primarily designed to produce healthy animals with desirable morphology and high productivity, congenital defects still occur in livestock. These defects may result from inherited gene mutations or arise from new mutations and DNA alterations. Congenital malformations, particularly those associated with heritable genetic variants, pose significant challenges in livestock production. They can hinder genetic progress, cause substantial economic losses due to animal mortality, and impair reproductive and productive traits, such as fertility and milk yield. In addition, such malformations negatively affect animal welfare, both directly—by reducing fitness and adaptability to farming conditions—and indirectly—by contributing to complications such as fetal dystocia [7]. Therefore, understanding the genetic basis of these disorders and developing effective strategies to eradicate them remain crucial goals for breeders seeking to minimize economic losses and improve overall herd health and welfare. The buffalo genome project and the genetic selection programs currently underway in several nations demonstrate that river buffalo is a species of growing interest worldwide due to its production capabilities. Still, congenital defects pose a hidden risk to animal production. These defects

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result in financial losses by lowering farm productivity [8].Reports on the prevalence of congenital abnormalities in river buffalo are limited worldwide, and a comprehensive account is still lacking. Among domestic animals, the most frequently documented craniofacial deformities include brachygnathia, prognathia, micrognathia, and clefts involving the palate, facial structures, or specific cranial bones [9]. Although animals with congenital defects are not suitable for breeding programs, their quality of life and survival rates can be significantly improved through timely and appropriate surgical intervention [4].

In the present study, a buffalo calf was presented with impaired suckling, accompanied by the presence of an abnormal hoof- and tail-like growth arising from the oral mucosa. The decision to pursue surgical intervention was guided by clinical findings obtained through visual inspection and physical examination. Subsequent histopathological evaluation was instrumental in determining the developmental origin of the lesion, verifying the tissue composition, and excluding any neoplastic involvement. The manifestation of hoof- and tail-like structures in the oral cavity is exceptionally rare, and this report documents a unique case and its successful surgical management in a buffalo calf.

MATERIAL AND METHODS

2. Case Presentation

2.1. Animal History and Clinical Signs

A 6-day-old male Murrah buffalo calf, weighing 38 kilograms, was presented to the Referral Veterinary Polyclinic, ICAR-IVRI, Izatnagar, with a complaint of difficulty in suckling and abnormal tissue growth in the oral cavity since birth. The calf was full-term, born to a multiparous dam via standard delivery, with no history of teratogenic exposure during gestation.

2.2. Physical Examination

Upon clinical examination of the calf, theconjunctival mucous membrane was slightly pale and well hydrated, the pre-scapular lymph node was normal in size, and rectal temperature, heart rate, and respiratory rateswere recorded as 102.5° F, 89 beats per minute, and 19 per minute, respectively. Hematological parameters revealed mild anemia (Red blood cells- 4.2 cumm/dl and hemoglobin- 8.1 g%), and the rest of the parameters were within normal limits. Serum biochemical analysis, including liver and kidney function tests, was also within normal limits.Upon physical examination, a firm, pedunculated hoof-like tissue approximately 3× 2 cm in size, along with a tail measuring about 15.5 cm in length, was observed arising from the right buccal mucosa, extending toward the oral commissure. The mass appeared to be composed of keratinized structures with hoof-like consistency (Figure **1A**) and a hair-bearing surface resembling tail tissue (Figure **1B**).

2.3. Surgical Management and Post-Operative Care

The calf was fasted for 24 hours and pre-medicated with Xylazine and Midazolam at 0.1 mg/kg and 0.2 mg/kg, respectively, intramuscularly. Preoperatively, the calf received an injection. Ringer's lactate solution: 10 ml/kg/hour IV inj. Streptopenicillin at 10000 IU/Kg, I/M and inj. Meloxicam at 0.2 mg/kg, I/M. Infraorbital nerve block was performed using 2% lignocaine hydrochloride along with local infiltration in a line block around the lesion and into the planned flap margins.

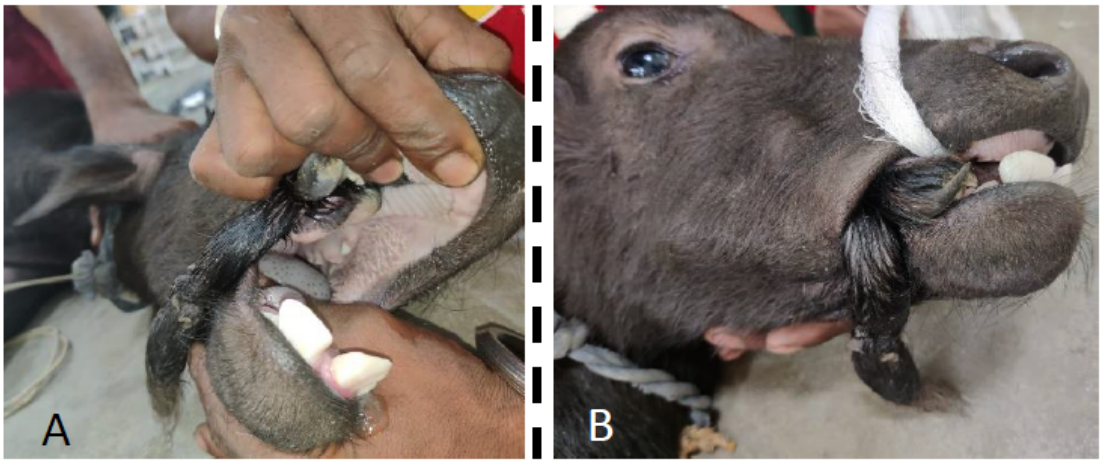

Figure 1: A. Unusual development of hoof-like; **B**.Tail-like structure in buccal space.

The calf was placed on dorsal recumbency with head extended and mouth held open with sterile roller gauze tied to upper and lower commissures; oral cavity isolated with suction and throat packing as needed to protect airway from blood/debris.

The surgical site was prepared aseptically using oral cavity lavage with sterile saline, followed by a gentle antiseptic 0.5% povidone-iodine solution for the oral mucosa, and the surgical field was draped. A mucosal elliptical incision was made around the keratinized mass. Buccal mucosal flaps were created and raised using sharp and blunt dissection (BP blade no. 21; Metzenbaum scissors and tissue forceps) to provide exposure and allow primary closure after removal of keratinised tissue at the abnormal site. Care was taken to preserve tissue for a tension-free closure. The stalk was carefully dissected free from the surrounding buccal mucosa and submucosa. During careful dissection, a single major feeding vessel was identified within the stalk. Temporary haemostasis was achieved by placing two mosquito clamps (proximal and distal) on the vessel while preparing definitive ligation. The feeding vessel was ligated using size 1-0 chromic catgut, which was placed proximal to the mass: the suture was passed through the vessel wall, a surgeon's knot followed by 3–4 square throws were placed to secure the ligature, and the vessel was transected distal to the ligature. The knot was trimmed, and the stump was observed for haemostasis. The keratinized, hoof-like mass was excised under aseptic conditions using the vessel-sealing electrosurgical device (Surgimech vessel sealer) to cut and seal the tissue pedicle with minimal lateral thermal spread. After excision, the remaining pinpoint bleeding was controlled with bipolar coagulation/monopolar coagulation at low power. Buccal mucosal flaps were advanced and closed in layers: mucosa approximated with size 1-0 catgut, simple interrupted sutures placed to achieve tight mucosal closure and eliminate dead space (Figure **2A**). Suture knots were buried where possible to reduce irritation.

The estimated total blood loss is approximately 8-10 mL. Catgut was chosen in this instance because it is an absorbable collagen (natural) suture providing adequate tensile strength for short-term tissue support and is commonly used in field settings, which is economical for farmers and also one of the readily available suture materials. The tissues were excised entirely, and samples were collected for histopathological examination (Figure **2B**). Postoperative care included parenteral antibiotics. Streptopenicillin at 10000 IU/Kg, q12 hours intramuscularly for 7 days and inj. Meloxicam at 0.2 mg/kg, q24 hours intramuscularly for five consecutive days, along with topical application of boro-glycerine gel paste to the oral cavity for 7–10 days. The calf exhibited an uneventful recovery, resumed regular suckling, and showed no recurrence during the 3-month follow-up period.

2.4. Histopathological Analysis

Excised tissue masses were fixed in 10% neutral buffered formalin for processing. After fixation, tissues were trimmed, dehydrated through graded alcohols, cleared in xylene, and embedded in paraffin. Sections of 4–5 µm thickness were cut and stained with haematoxylin and eosin (H&E) following [10]. The stained slides were examined under a Nikon ECLIPSE Ni-series microscope.

Histopathological analysis revealed well-differentiated hoof tissue. Histological details of the hoof tissues were mentioned in Figure **3**. Upon examination, there is no evidence of pleomorphism or teratological changes.

3. RESULTS AND DISCUSSION

This case report describes an exceptionally rare and unique congenital anomaly in a neonatal buffalo calf: the development of well-defined, hoof- and tail-like structures within the buccal mucosa. To the best of our knowledge, this is the first documented report of such a complex and anatomically distinct oral anomaly in a buffalo calf, adding a significant and unusual chapter to the veterinary literature on congenital disorders in ruminants. Although choristomas involving various tissues have been reported in the buccal mucosa, the presence of a hoof- and tail-like structure is unusual and has not been previously documented.

Congenital malformations pose a significant challenge in animal production, affecting an estimated 2–3.5% of all births. Musculoskeletal anomalies are among the most common, accounting for approximately 24% of reported cases [4]. These conditions not only impact individual animal welfare but also reduce herd productivity and reproductive efficiency, resulting in notable economic losses [4]. Congenital defects are malformations present at birth, arising from inherited genetic factors or non-genetic influences such as toxins or infectious agents. They are broadly classified as structural or functional

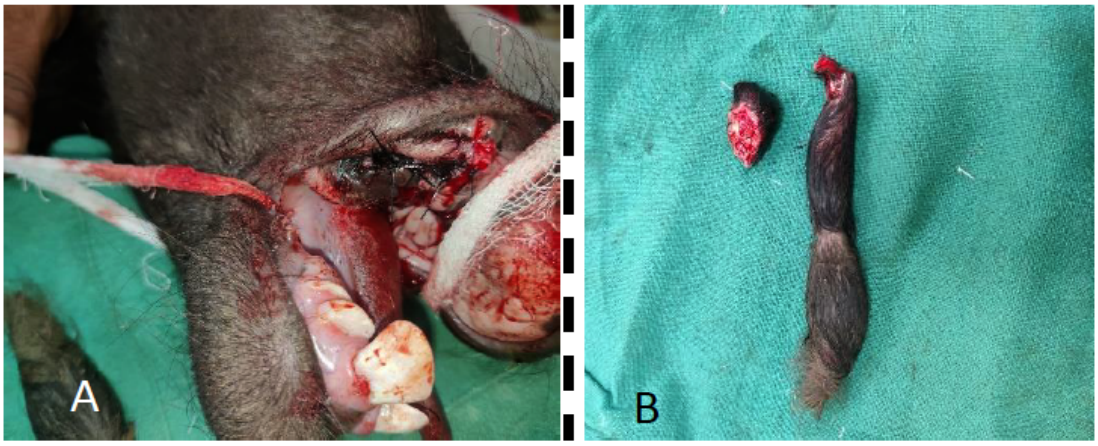

Figure 2: A. Suturing of buccal mucosal flap; **B**. Surgical excision of hoof & tail-like structures.

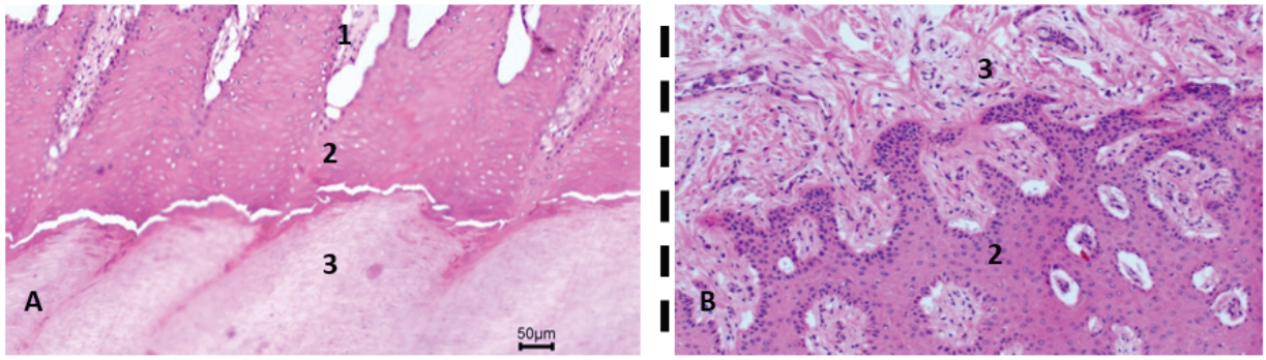

Figure 3: (**A**) Coronary region of the hoof composed of coronary dermis (1), dermal papillae (2), and coronary epidermis (3); (**B**) Shows the inner layers of the hoof, where the dermal papillae (2) are intertwined into the coronary dermis (3). H&E x200.

abnormalities [9]. Structural defects involve morphological anomalies, whereas functional disorders include metabolic or biochemical abnormalities [2,4]. Genetic mutations and chromosomal aberrations may further contribute to their etiology. Normal development of the face, jaws, and oral cavity depends on coordinated fusion of the frontonasal, maxillary, and mandibular processes. Owing to the complexity of this process, even minor disruptions can lead to diverse structural anomalies [11]. Congenital lesions involving the oral mucosa, including cysts derived from branchial arch remnants in ruminants, are exceedingly rare [12]. The congenital nature of this lesion raises the question of potential heritability. However, as no genetic analysis was performed, it is not possible to determine whether this represents a sporadic developmental anomaly or a heritable defect. Therefore, caution should be exercised when interpreting its genetic basis, and further studies, including genetic testing, would be required to clarify any heritable component.

The ectopic presence of a keratinized hoof- or tail-like appendage within the buccal mucosa indicates aberrant ectodermal differentiation, likely resulting from abnormal migration of pluripotent cells during early facial embryogenesis [9,11]. The term choristoma refers to a mass of histologically normal tissue located at an ectopic site. It is conceptually related to a hamartoma, differing mainly in that its constituent cells are not native to the site of occurrence. Derived from the Greek word chōristos (“separated”), choristoma is also described as an ectopia or heterotopia in developmental terminology [13]. A hamartoma is a developmental malformation composed of mature, disorganized tissues indigenous to the affected site. Although congenital in origin, it may manifest later in life and can clinically mimic a neoplasm; however, it is not an actual tumor. Histologically, hamartomas show an abnormal proportion or arrangement of native tissue components, generally exhibiting benign behavior and growth patterns proportional to those of adjacent normal tissues. Rarely, they may produce compressive effects or undergo neoplastic transformation [14].

Gastrulation, occurring during the third week of embryonic development, follows the blastula stage and

involves the transformation of the single-layered blastula into a multilayered gastrula comprising the ectoderm, mesoderm, and endoderm. This process establishes distinct cell lineages and defines the body axis for subsequent embryonic development [15]. During early facial development, neural crest cells and surface ectoderm migrate and differentiate into tissues of the face and oral cavity. If some ectodermal cells migrate abnormally or remain in ectopic locations, they can later differentiate into skin-like or keratinized structures [15,16]. The branchial (pharyngeal) arches form the basis of the face and neck. During normal development, the surface ectoderm fuses over these arches to form a continuous epithelial covering [17]. If fusion or separation is abnormal, ectodermal remnants may become trapped inside deeper tissues, where they can later form cysts or choristomas. Ectodermal placodes serve as the embryonic origin for a significant portion of the cranial sensory peripheral nervous system. Morphologically, these placodes appear as transient thickenings of the surface ectoderm at specific, conserved sites within the developing vertebrate head. Ectodermal placodes are specialized thickenings of ectoderm that give rise to sensory and glandular structures [18]. Misplacement of these placodal cells could lead to the formation of specialized ectodermal derivatives in abnormal sites, which might be another possible source of ectopic differentiation.

Studies by [19] indicate that congenital tumours and tumour-like lesions represent a spectrum of rare disorders originating from developmental tissue remnants. These lesions are typically detected either in utero or, more commonly, within the first few months of life—a pattern observed in both veterinary and human medicine. In calves, congenital tumours and tumour-like lesions comprise a diverse array of pathologies [20]. A widely accepted classification system, based on histologic and pathogenetic characteristics, groups these lesions into four major categories: embryonic tumours, malignant lymphomas, mesotheliomas, and hamartomas [13]. While clinical, radiological, and ultrasonographic examinations provide valuable preliminary information for diagnosing oral teratomas, histopathological evaluation remains the definitive diagnostic tool. Consistent with prior descriptions of teratoma histology [20, 21], the histopathological findings in the present case were critical for ruling out other differentials, including teratoma. Histologically, the lesion consisted solely of well-differentiated ectodermal elements, including keratinized stratified squamous epithelium and hair follicles. No mesodermal or endodermal structures were identified. Therefore, this lesion lacks the pluripotent germ-layer diversity characteristic of teratomas. As the tissue represents standard, mature ectodermal components occurring at an ectopic site, it is best classified as a choristoma (ectopic ectodermal differentiation), rather than a hamartoma or teratoma.

Examination of the abnormal growths, including the hoof- and tail-like lesions, revealed no evidence of teratological or tumorous changes, supporting the decision to proceed with surgical intervention. Given the limited number of reports and studies on congenital buccal growths in calves, systematic documentation of such cases is essential to strengthen the foundation for future etiological, diagnostic, and therapeutic research. Buccal masses or atypical growths may reflect a range of soft tissue conditions, and factors such as the animal's age, onset, and progression of swelling should guide differential diagnosis for unilateral buccal swellings. The size and anatomical location of these masses can affect feeding and vocalization or may result in mucosal injury and secondary infections. Surgically, meticulous excision that preserves adjacent oral tissues, along with histopathological evaluation, is advised to exclude differential diagnoses such as hamartoma, choristomas, teratomas, or other neoplastic lesions [13, 22]. In the present case, the decision to proceed with surgical management was primarily guided by the findings of the visual inspection and physical and clinical examinations. At the same time, a definitive diagnosis was established through histopathological evaluation of the excised tissue to rule out teratomas [23]. The hoof- and tail-like appearance of the lesion, along with its consistency relative to the adjacent structures, provided valuable clinical indications. Such features, when carefully assessed, may offer important insights into the underlying pathophysiology and help distinguish this anomaly from other potential differential diagnoses. The tissue of origin is used to categorize common lesions that cause unilateral swellings of the buccal area[5]. Apart from congenital anomalies, other aetiologies for space-occupying growth in the oral cavity include infections, inflammation, benign lesions, and malignant neoplastic diseases, which can result in unilateral swellings of the buccal mucosa. Acute unilateral swelling is most frequently caused by odontogenic infections spreading to the buccal region, or by tumours of muscular origin [23].

Surgical excision was selected as the treatment of choice, with complete resection and histological confirmation of clear margins proving essential to prevent recurrence. The excellent post-operative

recovery and the immediate resumption of normal suckling behaviour indicated that the mass was solely responsible for the clinical signs. Prognosis in such cases is generally favourable, provided timely intervention and complete excision are achieved, as these lesions are non-malignant and, in this instance, were not associated with any internal anomalies. This case underscores the potential for developmental anomalies and highlights the need for clinicians to consider congenital choristomas among the differential diagnoses for oral masses in neonates. Moreover, it reinforces the critical role of histopathological evaluation in establishing a definitive diagnosis and guiding prognosis.

The animal was monitored weekly for the first month and biweekly thereafter for a total of three months. No postoperative complications or recurrence were observed. The surgical site healed uneventfully without scar contracture or feeding difficulty. The animal maintained normal suckling behaviour and exhibited regular weight gain throughout the follow-up period.

CONCLUSIONS

This report describes an exceedingly rare and unreported congenital anomaly in a buffalo calf. It contributes a unique entity to the veterinary literature oncongenital malformations in large animals. The growth's unusual resemblance to a hoof and tail provides a fascinating insight into the potential for profound developmental errors in embryonic tissue differentiation. While the exact etiopathogenesis remains unclear, complete surgical excision proved to be a simple and effective treatment, ensuring the animal's welfare and survival. This report serves to inform clinicians about the unusual presentations that may occur in large-animal neonatology and emphasizes the value of histopathological evaluation for definitive diagnosis. The most effective strategy for controlling genetic diseases is to prevent breeding animals that carry defective genes. Although the lesion may suggest a developmental anomaly, the absence of genetic testing limits conclusions regarding heritability. The condition is most likely sporadic, but a heritable basis cannot be entirely excluded. Additionally, prompt surgical intervention should be recommended to preserve and enhance the quality of life in affected newborn animals. The case highlights the importance of detailed reporting to aid future recognition.

ANIMAL RIGHT

Animal handling and management procedures were performed in accordance with institutional animal care guidelines. The authors attest that they have complied with the journal's ethical standards, which are listed on the author rules page.

ETHICAL APPROVAL

According to institutional policy, formal animal ethics committee approval was not required for single-case clinical management. Informed consent for treatment, submission, and publication of clinical images was obtained from the owner.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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