Pulse Granuloma as a Complication Following Dental Trauma in Children

Makkada Yuvaraj Padmanabhan, BDS, MDS
Radhakrishnan Aparna, BDS, MDS
Shanmugasundaram Karthikeyani, BDS, MDS
Jayakumar Dinakar, BDS, MDS
Menaka Manickaraj, BDS, MDS

ABSTRACT

Contamination and subsequent retention of foreign bodies within wound surfaces may negatively influence healing following maxillofacial injuries. Larger foreign bodies that produce embedded or impalement injuries of soft tissues are easily detected. However, smaller contaminants, such as sand, gravel, food particles, wood splinters, and glass fibers, may not be easily identified in the initial examination, and their remnants may remain within the injury site even after debridement. Tissue reactions depend on the host response, type of foreign body, and nature of the wound surface. The purposes of this report are to: (1) detail the diagnosis and management of a peripheral pulse granuloma following retention of food particles within gingival sulci during a dental injury; and (2) provide a brief review of the diagnosis of foreign body-induced granulomas following maxillofacial injuries in children. (J Dent Child 2013;80(3):121-5)

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Examination of the oral soft tissue wound surfaces should involve a careful inspection for the presence of foreign bodies (**FBs**).[1] Displacement of foreign substances within oral soft tissue wound surfaces may commonly occur following abrasions, lacerations, or loss of soft tissues. Contusive injuries of gingiva, however, may also be associated with retained FBs within the gingival sulci.

Retained FBs may be missed upon initial evaluation due to local factors, such as bleeding, edema, exudation, pain and tenderness on the wound surface. Furthermore, other factors may prevent proper evaluation, such as uncooperative behavior of young patients, and the absence of caregivers during the traumatic episode to provide a proper account of the events. The complications associated with retention of FBs within wound surfaces include soft tissue deformities, improper wound healing, complications associated with localized and systemic infections, and increased patient discomfort.

Prolonged retention of foreign substances within soft tissues may initiate granulomatous inflammatory reactions when they are not ingested by local macrophages.[2] FBs like pulses may lead to a specific type of granulomatous reaction, which has been termed a "pulse granuloma" or "hyaline ring granuloma."[3,4]

Studies related to experimental production of pulse granulomas (**PGs**) in animals have reported initiation of these lesions as early as the third day following implantation of leguminous substances (lentils, peas, beans, etc) within cavities prepared in the mandibular bone.[5] The initial inflammatory cell infiltrate surrounding these FBs are predominantly neutrophils and macrophages, while multinucleate foreign body giant cells were evidenced at later stages.[5] The histological structure of a pulse is that of a shell enclosing a cotyledon, which is a honeycombed structure containing starch granules within them. On boiling, pulses lose

Dr. Padmanabhan is senior lecturer and Dr. Karthikeyani is reader, Department of Pedodontics and Preventive Dentistry, and Dr. Dinakar is professor and head, Department of Oral Pathology, all at Sri Ramakrishna Dental College and Hospital, Coimbatore, India; and Dr. Aparna is a periodontist and Dr. Manickaraj is a pediatric dentist, both in private practice, Coimbatore, India.
Correspond with Dr. Padmanabhan at dentistpad@rediffmail.com

the honeycombed structure and present as clusters of loosely floating starch granules enclosed by thin cellulose envelopes. When these pulses are implanted within tissues, they may initiate a granulomatous response which involves disintegration of the lentil cells, digestion of starch granules, and deposition of hyaline rings around the disintegrating cells. In persisting lesions, the hyaline rings are replaced by basophilic granular materials, which marks the onset of calcification of the complete mass.[5]

In a classical animal study to assess the histological reaction to subcutaneously implanted vegetable matter, it was found that leguminous substances evoked a granulomatous response similar to oral PGs, while rice, apples, corn, celery, chips, lettuce, and tobacco failed to initiate any such reponse.[6] Following a series of animal experiments, Knoblich[7] found that the shell and cell wall components initiated granulomatous reactions while injection of starch granules alone did not evoke a similar reaction. He inferred that leguminous cellulose, by virtue of its high resistance to digestion by tissue macrophages, was the key agent that initiated granulomas. The protein matter, which has the ability to evoke an allergic response, and phytohemagglutinins, which have granuloma enhancing properties, were also suggested as possible granuloma inducers.

PGs have been reported to occur in most parts of the body, including the lungs,[7] gastrointestinal tract,[8,9] and periprostatic soft tissues,[10] aside from the oral and maxillofacial region. In almost all of these cases, there was a breach in the continuity of the epithelium, such as an ulcer,[8] diverticulum,[11,12] fistula,[13,14] or an iatrogenic implantation during a surgical procedure,[10] through which food particles got displaced into the subepithelial region, leading to a granulomatous inflammatory reaction.

In the oral cavity, PGs have been predominantly reported in mandibular edentulous posterior ridges. PGs were also associated with leguminous substances embedded within these ridges due to pressure of the overlying denture or through displacement of vegetable matter into extraction sockets.[3,15] Additionally, PGs were reported in the periapical region of carious tooth/root stumps that remained open to the oral environment for a long time due to nontreatment or partial/failed endodontic treatment.[3,16,17] PGs are predominantly managed by surgical excision when they present as a peripheral growth or swelling, and the recurrence rate of these lesions is negligibly low.[4]

The purposes of this report are: (1) to detail the diagnosis and management of a unique case of peripheral PG following retention of food particles within gingival sulci during a dental injury; and (2) to provide a brief review of the factors that can aid in the diagnosis of FB-induced granulomas following maxillofacial injuries in children.

CASE REPORT

A healthy 30-month-old boy was referred to the Department of Pedodontics and Preventive Dentistry at the Sri Ramakrishna Dental College and Hospital, Coimbatore, India, with complaints of a soft hemorrhagic growth emerging from the gingival sulcus above the maxillary incisors (Figure 1).The child had fallen down in the kitchen over a metal plate containing food 10 days before and hit the incisors, which resulted in bleeding from the gingival sulci. The mother pressed the site with a wet cloth, and later wiped the mouth to remove the residual food material. She fed the patient the same type of food three hours after the trauma and consulted a general dentist the following day. The dentist made a diagnosis of subluxation of the incisors and gingival eechymosis due to contusive injuries. The patient was prescribed oral analgesics and was then referred to the dental school for follow-up. The gingival growth was first noticed one week after the incident and rapidly grew in size (Figure 1). The parents also reported tenderness and bleeding from the mass, even on mild touch.

The patient was of normal height and weight for his age. There was no history of drug allergies, chronic disease, surgery, or hospitalization in the recent past. On examination, a single soft friable mass measuring 11 mm x 5 mm, which bled upon the slightest palpation, was observed to emerge from the labial gingival sulci above the primary maxillary central incisors (Figure 1). The gingival growth displaced the maxillary right

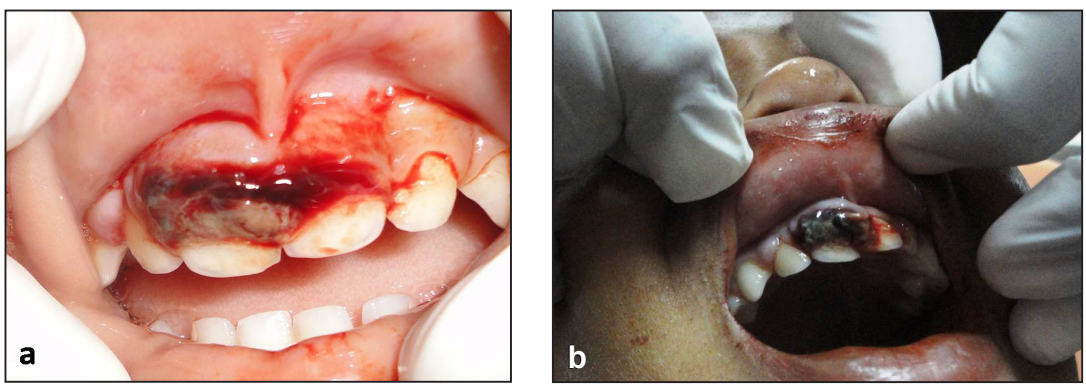

Figure 1. (a) Pulse granuloma presenting as a sulcular growth and (b) displacing the maxillary primary central right incisor palatally.

central incisor palatally, and both central incisors and the right lateral incisor presented class I mobility. Periapical radiographs of the area revealed no signs of radiolucencies, root fractures,or abnormal root resorption patterns.

Based on the history and clinical findings, a provisional diagnosis of a benign, rapidly enlarging peripheral FB granuloma secondary to impaction of FB in the injured site was made. Peripheral giant cell granuloma was considered in the differential diagnosis. It was decided to treat the lesion by surgical excision under local anesthesia and sedation.

Under deep sedation using intravenous midazolam, 2 percent lignocaine with 1:200,000 adrenaline was infiltrated into the mucobuccal fold above the maxillary incisors. The gingival overgrowth was surgically detached from the sulcular surface of the gingival epithelium, and the area was curetted to remove remnants. Hemostasis was achieved with a pressure pack, and sutures were not required. Ibuprofen (100 mg/5 ml) every eight hours and povidone-iodine to be used topically in the area were prescribed.

Conventional histopathological examination of the excised lesion with hematoxylin and eosin staining revealed empty, ellipsoidal, septate bodies in a connective tissue background showing dense infiltration of nonspecific chronic inflammatory cells and few multinucleated giant cells. The outer rim and septae of these ellipsoid bodies were eosinophilic; however, no staining could be observed within the contents of these vacuolated bodies (Figure 2). An ulcerated stratified epithelium could be observed overlying the inflamed submucosa. The uptake of histological stains by these

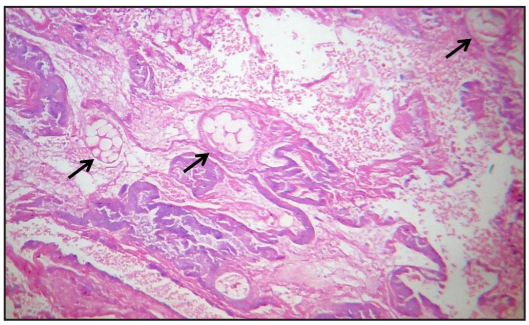

Figure 2. Haematoxylin and eosin staining of excised tissue specimen revealing ellipsoid, septate bodies (black arrows) suggestive of pulses (420x magnification).

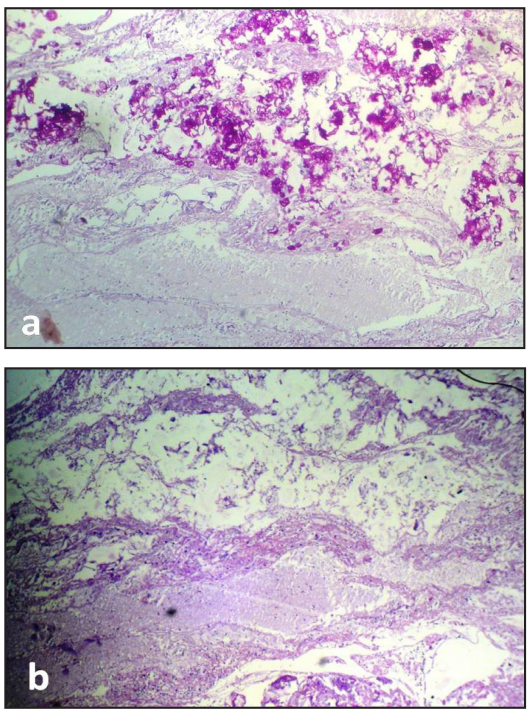

Figure 3. Periodic acid Schiff (PAS) stain uptake (100x magnification) (a) without diastase digestion and (b) after diastase digestion at a similar site in the tissue specimen. (b) No uptake of PAS stain is observed following diastase application due to enzymatic degradation of starch moiety.

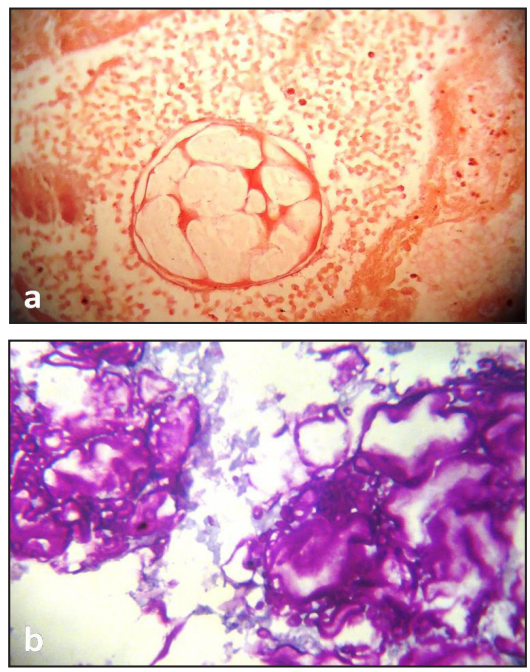

Figure 4. (a) van Gieson staining of fibrous portion of the pulses and (b) periodic acid Schiff stain (without diastase) uptake observed in both the walls and starch granules (620x magnification).

Figure 5. Intraoral view after 4 years revealing no abnormalities in structure or eruption of the permanent central incisors.

ellipsoidal bodies were suggestive of food particles, most probably leguminous substances.[6]

To confirm this diagnosis, the tissue specimens were subjected to special stains, such as periodic acid Schiff (**PAS**) and van Gieson stains. The uptake of PAS stain was observed in the outer rim and the contents of the ellipsoid bodies, suggesting the presence of polysaccharides (carbohydrates), which was further confirmed by the absence of stain uptake following diastase digestion (Figures 3 and 4). Faint uptake of van Gieson stain, however, was identified only in the outer rim and septae of these ellipsoid structures (fibrous stroma). The results of these staining reactions suggested that the retained FBs were pulses, which have a structure consisting of a fibrous outer rim (with a cell wall containing cellulose) and cotyledon with carbohydrate (starch) content within these structures. Based on the history, clinical findings, and histopathological results, a final diagnosis of peripheral PG caused retained leguminous substances within the gingival sulci was made.

A one-week follow-up after surgery revealed good healing of the area. No recurrence or tooth mobility was observed at the 6-month follow-up visit. Four years later, no developmental abnormalities were observed in the permanent right maxillary central incisor (Figure 5).

DISCUSSION

The present case is unique because (1) the occurrence of PG following an oral traumatic injury in a young child has never been reported; (2) PG as a gingival mass possibly emerging from the gingival sulcus is rare; and (3) there is a lack of reports describing the management of such lesions in toddlers and the potential impact of these complications on the developing dentition.

Philipsen and Reichart,[3] after reviewing the literature related to pulse or hyaline ring granuloma, reported that the youngest patient to have presented with this lesion was approximately 6 years old. Most of these lesions have been reported in adults, with a predilection for males. Edentulous mandibular posterior regions or walls of odontogenic cysts are common sites of occurrence of PGs. They are usually detected following a clinical presentation of pain, swelling, recurrent discharge, or a nonhealing sinus or during routine clinical, radiological, and/or histological examination.[3]

The uptake of PAS stain by the FBs is suggestive of the presence of carbohydrates in the form of polysaccharides in the cell wall and starch granules within the cells. In animal model studies, deposition of collagen at the surface around the retained pulses results in a high uptake of van Gieson's stain around the outer shell.[5] In the present case, faint uptake of van Gieson's stain was observed in the outer rim, as the lesion was excised at an early stage, which explains the presence of fewer multinucleated giant cells. Similarly, the intact to mildly disintegrated structure of the embedded pulses within the specimen is also attributed to the early excision of these lesions, which explains the lack of complete disintegration of lentil cells or calcification within the zone of inflammation. Antibiotics were not considered necessary, as the patient did not present with any systemic and local signs of infection and because PGs (or any other FB granulomas) do not have an infectious origin. Local antiseptic irrigation, however, was advised to prevent bacterial colonization and accumulation of food debris around the surgical wound in order to facilitate better healing.

Traumatic impaction of food substances in the gingival sulci or periodontal pocket has been reported to result in periodontal abscess due to the acute inflammatory process associated with tissue injury. In the present case, retention of pulse fragments within sulcular wound surfaces could have occurred more passively, resulting in a granuloma. Recurrent or non-healing swellings, abnormal tissue growth, and prolonged/recurrent discharge from the sinuses are common findings that aid in diagnosing FB granulomas. The Table lists commonly reported retained foreign substances

Table. Characteristics of granulomatous reactions associated with common exogenous foreign substances retained within tissues

Foreign substance	Findings of interest in foreign body granulomas
Vegetable /plant matter/ leguminous substances	Their presence is substantiated by special stains such as the von Giesson stain, and by PAS stains, which identify starch and cellulose content. There are no specific radiographic findings.
Glass or glass fibers	Glass/glass fiber-induced granulomas in the oral region have not been reported. In histological sections, glass fibers are observed as birefractive structures. [18] Regular nonleaded glass is radiopaque and easily visible in sections larger than 2 mm,[2] unless superimposition of surrounding structures obscures its presence.[19]
Wood splinters	There are no special stains for diagnosis. Wood may not be visible on conventional film radiographs. Computed tomography images may be misleading initially, as they may mimic air (bubbles); however, over time, due to absorption of moisture, their attenuation value may increase and appear denser. Magnetic Resonance Imaging is useful in identifying changes in adjacent tissues, and the embedded wood fragment may produce a varying intensity of signals. Wood fragments may appear as highly echogenic objects with pronounced acoustic shadowing in sonographs.[20-22]
Graphite and metal-based fragments	May cause pigmentation of surrounding tissues. These substances appear radiopaque (except aluminum) in conventional radiographs and hyperdense in computed tomography scans.[20,21,23,24]

within wound surfaces and their distinct findings that can aid in the diagnosis.

During history taking, emphasis needs to be placed on the agents contaminating the wound region during the injury and the healing phase in order to allow early diagnosis. Similarly, care should be taken to ensure proper debridement of soft tissues (particularly in the sulcular region) to avoid entrapment of FBs underneath the healing mucosa. The importance of keeping wound surfaces clean should also be thoroughly explained to patients and their caregivers to avoid healing complications.

CONCLUSION

FB granulomas should be considered in the differential diagnosis of growths originating from the region around soft tissue wound surfaces.

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