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Overextension of root canal filling: a leading cause of maxillary sinus aspergillosis- A review

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Abstract

The overextension of root canal filling material into the maxillary sinus often leads to an array of clinical signs and symptoms. Maxillary sinus aspergillosis is a clinical compilation of overfilled root canals. The heavy materials present in these cements often provide a protective niche for the growth and proliferation of opportunistic fungi Aspergillus. These spores are routinely inhaled and exhaled and does not cause any significant problems. However the extrusion of materials into the sinus provides a favourable environment for these fungi. The clinical symptoms ranges from unilateral pain in the cheek region, headache, nasal discharge, heaviness etc.The identification of the disease requires a thorough understanding of the patients past dental history and radiographic evaluation. Orthopantomagram and cone beam computed tomography helps in the thorough visualization of the pathology. The histological evaluation of the specimens reveals fungi septae. The treatment is aimed to completely remove the fungal overgrowth with the causative agents i.e root canal cements inside the sinus. This review aims to give a comprehensive overview of the etiology, pathogenesis, diagnosis and treatment of maxillary sinus aspergillosis.

Keywords: Maxillary sinus, aspergillosis, gutta percha, endodontic sealer, sinus aspergillosis, aspergillus, fungi balls.

Introduction

Overfilling of the root canal space is an iatrogenic error often committed by the dentist. The success rate of overfilled root canal is as high as 89.8% and failure is deemed to be 10.2%. The patients despite having an overfilled root canal space often remain asymptomatic. The most commonly used root canal filling material is gutta percha. The overextension of gutta percha beyond the periapex can cause damage to the periapical stem cells and cause defective healing. Despite violating the periapical space the success rate is deemed to be high due to the proper cleaning of the root canal space eliminating most of the microorganisms. The inert nature of gutta percha and the gradual resorption of gutta percha adds on to the long term success of over extended root canal filling cases.[1]

However in recent years there has been documented case of aspergillosis of the maxillary sinus as a complication to endodontic treatment. Aspergillosis an opportunistic fungal infection is very rarely found to affect non immunocompromised individuals. Aspergillus species are rather common in the environment, belongs to the Ascomycetes class of fungi.[2] There are about 900 reported species of aspergillus but very few species like Aspergillus fumigatus, Aspergillus flavus, Aspergillus niger, and Aspergillosis terreus are reported to be infective to humans. Based on the clinical nature they are divided into 3 types ie

1. noninvasive
2. Invasive
3. allergic variants

The no invasive form of aspergillus mycetoma is of greater concern to the dentist. They occur as opportunistic infection in healthy individuals. Fungi balls or aspergilloma is known to invade maxillary sinus.[3] Various case reports around the globe point to aspergillosis of the maxillary sinus following endodontic treatment. These reports suggest a strong correlation between the cement used for the root canal filling procedure and the development of aspergillosis. Such cases often present as an enigma to the physician and the dentist due to the inability to reach a proper diagnosis. Hence this review aims to identify the nature, course and the treatment options following aspergillosis of the maxillary sinus as a complication of endodontic treatment.

Maxillary sinusitis: a misdiagnosis

The extensive literature review has shown that patients often patients may report to the physician or otolaryngologist or dentist with varying symptoms that includes pain in the ear, nose or upper teeth region, discharge, headaches or heaviness in the head.[4-7] Post evaluation of the patient, clinicians often render diagnosis as " maxillary sinusitis". Hence the treatment follows the regimen advised to eliminate this infection, thereby masking the key etiology which needs to be completely removed for the resolution of the ailment. Clinicians often fail to elicit a proper case history and employ adjunct diagnostic tools in these patients resulting in their prolonged distress and unwanted therapeutic interventions. Repeated history of refractory sinusitis like symptoms should always raise the question of past dental treatment to rule out any other possibilities.

Role of Case history and radiological examinations

Case history: Patients with compromised immune status due to debilitating conditions such as blood disorders or malignant tumors often present with mycosis. The occurrence of aspergillosis in healthy patients is relatively rare. Patients often present with unilateral pain in the sinus.

Case history often reveals history of past endodontic intervention in the maxillary posterior teeth. A mean interval of 6 years is noted prior to the onset of symptoms.

Radiology

Radiological diagnostic aids such as OPG, CBCT or CT along with IOPAR aids in the diagnostic aspects. The readily available exposures in radiology are panoramic and periapical views. The sinus floor along with its relation to the roots of maxillary teeth can be easily viewed in the panoramic view. Extruded sealers and obturating materials are viewed as radiodense objects in the radiograph and clearly helps in the diagnosis. CBCT and CT are more sensitive for evaluating maxillary sinus. They can be viewed in different planes and axes leading to a 3D visualisation. This helps to localise the foreign body if present in sinus space and its dimension can also be determined. Alteration of the sinus wall thickening could be differentiated through CT/CBCT suggestive of inflammation of the maxillary sinus.[1] With the radiographic evidence and past dental history clinicians could clearly isolate the etiological factor and initiate proper treatment for the patients. [3-4]

On radiographic examination, radiodense objects are noted in the sinus.Stammberger and colleagues have described the radiologic appearance of aspergillosis of the maxillary sinus. Patients presented with an object of radiodensity with diameter varying from 1 to 14mm. They can lie toward the centre or towards the opening of the antrum or elsewhere in the sinus without contacting the walls of the sinus. Preoperative radiographs reveal endodontically treated maxillary teeth or missing tooth suggestive of extraction of teeth. Radiopaque concrements are found in the cloudy sinus. Radiographically bone destructions cannot be accounted.[8]

Gutta percha and root canal cements

Gutta percha is extensively used as an obturating material due to its inertness and biocompatibility. The major component of gutta percha includes zinc oxide which constitutes 66% of its volume. Zinc being a heavy metal act as an inoculum for the growth and proliferation of fungi in the maxillary sinus.[9] Studies by Legent et al [10] demonstrated that 85% of maxillary sinus aspergillosis is due to over extended sealers. Cases that are diagnosed with maxillary sinus aspergillus are due to the iatrogenic placement of endodontic filling material into the sinus. The pathogenesis of aspergillosis of maxillary sinus is attributed to the zinc oxide containing endodontic materials. Finite elemental analysis of fungi balls by Nicolai et al[11] in 2015 found significantly higher amounts of metals in fungi balls than the mucosa.

Pathogenesis

Aspergillus spore are abundantly present in the environment. They are often inhaled into our systems and are found in the sinuses. In a compromised patient these spores proliferate defeating the innate immunity and cause opportunistic full blown infections. However in an healthy individual, the ciliated respiratory epithelium continuously removes these spores and prevent any infection.

The presence of heavy metals in the maxillary sinus act as nidus for the spore to hide. By paralysing the cilia or by inducing soft tissue hypervascularization and oedema, these trace elements may cause an alteration of the respiratory epithelium. This leads to the retention of the spores in the maxillary sinus. The heavy metals and the altered respiratory epithelium act as niche for the growth and proliferation of the fungi. [12]

The extracellular metabolites released from filamentous fungi are capable of deteriorating heavy metals. But under certain conditions these fungi can precipitate these heavy metals into other mineral phases. Species of aspergillus fungi react to ZnO particles by production of excess extracellular metabolites and immobilizes the zinc. They also transform the ZnO particles into a more stable oxalate particles. Ross et al demonstrated that aspergillus species

require heavy metals for the proliferation and metabolism process. [13-14]

Accidental expression of root filling material containing zinc oxide and paraformaldehyde causes tissue irritation and leads to local necrosis of the antral mucosa. zinc oxide is available to permit and accelerate the growth of airborne aspergillus spores inhaled by the patient through the nose. Because the expressed root-filling material does not remain in one specific area of the antrum, concentric layers of fungal hyphae are intermittently deposited around its periphery, thus leading to the typical fungus ball appearance. The ciliated mucosal cells tend to move the concrement toward the natural orifice of the antrum. At this stage, the orifice may become occluded and mucous retention and suppuration may ensue. The pressure in the antrum can cause a small concrement or parts of it to be expelled and lost via the nose. Conversely, bacterial superinfection can lead to bony destruction of the antral walls and give an impression of fungal invasion or of a malignant neoplastic lesion.

Clinical findings and Management

Symptoms vary among patients and are inconclusive. Patients often remain asymptomatic and are identified by routine radiographic examinations. Symptomatic patients present with persistent pain in the region of upper jaw, otalgia, headaches, heaviness and nasal discharge that mimics maxillary sinusitis. The evaluation of the endodontic intervention would reveal that there is extrusion into the maxillary sinus. Antral drainage will alleviate the symptoms temporarily, but the mycotic material persisting in the sinus will lead to continued infection. Lavage using antibiotics is contraindicated since it will promote further fungal growth. Patients may complain of persisting pain in the endodontically treated tooth and would have got the teeth extracted, but the remnants of the filling material in the sinus will cause continuum of the disease. The total debridement of the affected sinus is the only effective treatment of Sinus aspergillus . Depending on the clinical and radiological findings, access will be gained through a transoral antrostomy or through a lateral rhinotomy. [15]

The microscopic examinations of such specimens revealed septate hyphae with 45^0 branching with adjacent inflammatory response. This hyphae could invade the adjacent vessels, occlude them and result in necrosis.[16] Mycotic sinusitis remains asymptomatic for a long period of time making early detection impossible.

Conclusion

The knowledge and thorough understanding of maxillary sinus anatomy is of utmost importance to the dentist. The proximity of the roots to the floor of the sinus can led to iatrogenic extrusion of materials. These materials in the long course of time leads to proliferation of the fungal spores. Radiographic evaluation helps to acknowledge the condition and helps in its treatment course. The forigne body invasion of maxillary sinus is highly unpleasant. The heavy metals present in them favours opportunistic infection growth. While performing root canal therapy for care has to be taken while cleaning, debriding and obturating the canal space. A very minute cement inside the canal space in due course of time can lead to a full blown fungal infection. Surgical intervention is the only treatment option of this course of disease.

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