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Short Review

Effect of Adversities in Endodontics on Maxillary Sinus: Maxillary Sinusitis of Endodontic Origin – A Short Review

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Abstract

Maxillary sinusitis of endodontic origin is basically an endodontic infection extending into the maxillary sinus. Scientific research and prevalence show that periapical infections manifesting in the sinus are under appreciated and gets neglected by specialists. Better understanding of the origin and the condition and the discussion with ENT specialists is important to diagnose endodontic origin of sinusitis and to differentiate sinogenic sinusitis. Identification and treatment of maxillary sinusitis of endodontic origin is of utmost importance as these left untreated can lead to persistence of sinus disease with failure of the medical therapies and the progression to more advanced stage or even life-threatening cranio-facial infections.

Keywords: Odontogenic origin, periapical osteoperiostitis, sinusitis

Introduction

Root canal treatment is one of the most technically challenging procedures in dentistry,[1] encompassing the procedure that are meant to maintain the health of all or part of the pulp. When the pulp is diseased or injured, treatment is aimed at preserving normal periradicular tissues. When pulpal disease has spread to the periradicular tissues, the treatment is aimed at restoring them to health.[1,2]

The objective of root canal therapy is to remove the infected pulp, necrotic debris, and the microorganisms from the root canal to re-establish the health of the pulp and the periradicular tissues.[3] Diagnosis, treatment planning, good knowledge of the root canal system and its frequent variations, ability to locate, shape mechanically, clean chemically and adequately fill all the canals of root canal system are vital for reestablishing the healthy state of the tooth and the periradicular tissues.[4]

Complications of the endodontic treatment procedure occurs, if the treatment has not been done up to acceptable standards. According to the tooth type, the majority of the root canal failures were observed in maxillary molars (44.4%) followed by mandibular molars (20%) and maxillary premolars (15.5%) with the major factors responsible were for these failures were underfilled, unfilled and missed canals. Hence, it was concluded that significant chances of complications and failure were noted to be in the maxillary tooth.[5,6] A complication in the maxillary tooth following a root canal therapy can also occur as the result of over-instrumentation, extrusion of irrigants, intracanal medicaments, sealers and the obturating materials, due to the close anatomical inter-relationship of the maxillary sinus and the roots of the upper posterior teeth.[7]

Complications and failures of the maxillary tooth can lead to the sequelae of periapical infections followed by the inflammation or the infection of maxillary sinus due to its near proximity to the root apex. Maxillary sinusitis, inflammation or the infection of maxillary sinus due to the failure or as a complication of endodontic procedure is termed specifically as maxillary sinusitis of endodontic origin.[8,9]

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Maxillary Sinus and Dental Infections

Maxillary sinus, a pneumatic space is the largest bilateral sinus which is pyramid in shape. Placed in the body of the maxilla opening into the middle nasal meatus of the nasal cavity with single or multiple openings and the sinus varies in position, size and shape not only in individuals but also in different sides of the same individual. Thus dimensions of the maxillary sinus vary considerably among the gender, ethnic groups, and of different age groups. Considering the anatomical variability related to the maxillary sinus, its intimate relation to the maxillary posterior teeth and their implications are of utmost importance.[8,10]

Depending on the dental pathogenicity, anatomic factors, the extent of mucosal edema and sinus ostial patency, periradicular inflammation may progress beyond the antral floor causing a partial or total obstruction of the maxillary sinus with symptoms and radiographic presentation common to sinogenic sinusitis.[8] Care must be taken during the dental treatment and particularly endodontic procedures as the bone of the maxillary sinus can be very thin. In some individuals, the roots of the premolars and posterior tooth are covered only by Schinederian membrane of the respiratory epithelium.[8-10]

Usually, the alveolar bone and the sinus membrane that separates the apices of the teeth and the maxillary sinus may be thin or even absent (pneumatization) and tends to occur with increasing age.[8,11]

Maxillary Sinusitis of Dental Origin, Odontogenic Sinusitis, Odonotgenic Rhinosinusitis, and Odontogenic Maxillary sinusitis are all used synonymously. Periodontal diseases, endodontic disease, root fractures, dental implants, dental extractions, oro-antral fistulae, and iatrogenic causes such as extruded dental materials, displaced tooth, and foreign bodies are all odontogenic sources of sinusitis. It is important to distinguish these etiologies from Maxillary Sinusitis of Endodontic Origin (MSEO) (previously termed as the endo antral syndrome) as they each require different clinical treatments. MSEO requires an accurate diagnosis of the condition followed by appropriate endodontic treatment or extraction to remove the source of endodontic pathogens associated with the periapical disease and secondary sinus infection.[8-11]

Hence, the purpose of this review is to present the adversities of over-instrumentation, extrusion of irrigants, intracanal medicaments, missed canals, sealers, and the obturation materials on the maxillary sinus that can progress to maxillary sinusitis along with how to diagnose and the treat the same.

Intracanal Medicaments

Intracanal medicaments are temporary canal filling pastes or temporary root canal dressing materials; these are basically calcium hydroxide based, iodoform based and antibiotic based.[12,13]

Calcium hydroxide-based intracanal medicaments consist of water-based calcium hydroxide, barium sulfate, and propylene glycol. Iodoform-based intracanal medicaments composed of calcium hydroxide, iodoform with the addition of silicon oil. Antibiotic-based intracanal medicaments comprising of metronidazole, ciprofloxacin, and doxycycline which are custom prepared by mixing either with saline, lcal anesthetic solution, distilled water, or the solvent like propylene glycol.[12-14]

Calcium hydroxide and barium sulphate are supposed to be safe and play a beneficial role in the periapical area, slowly resorbed without tissue damage. Propylene glycol one of the major component be able to produce toxic effects when extruded into periapical area, toxic effects may appear as the primary foreign-body reaction by macrophages rather than severe inflammation or allergic reaction.[12,15]

Intracanal medicaments which consist of irritating substances such as magnesium and silicon as in iodoform-based intracanal medicaments also evoke foreign-body reaction at the periapex.[12]

Hence, the conclusion can be drawn that foreign-body reactions at the periapex either due to propylene glycol or the silicon can lead to the development of asymptomatic periapical lesions that may remain refractory to endodontic therapy for long periods, in turn progressing to foreign body granuloma in periapex propogating to maxillary sinusitis.[7,12]

Irrigants

The main objective of root canal therapy is to mechanically prepare and remove the microorganisms in an infected canal systems, but mechanical preparation alone will not ensure a microbial free environment, for the same reason active irrigants are routinely added to the treatment protocol.[11,16]

Sodium hypochlorite, one of the most commonly used chemical agent for disinfection of root canal as an irrigant, has the potential to cause complications if extruded beyond the apex and consequences subsequent to this is termed as sodium hypochlorite accident.[8,11,16,17]

Sodium hypochlorite is a tissue cytotoxic agent and is an effective solvent for both necrotic and the vital tissues. When it comes in contact with the vital tissues, it causes hemolysis, ulceration, and also effects vascular permeability not only damaging the vessels but also stimulates the release of chemical mediators. Initial hemorrhage is a common complication from extrusion, leading to immediate swelling and severe bleeding.[11] Extruded solution into the sinus can also move to the middle meatus of the nasal cavity through the hiatus semilunaris and thus discharging out of the nostril, eventually results in the acute sinusitis and associated bleeding into interstitial tissues and ecchymosis of the surrounding mucosa, facial skin and also the formation of hematoma.[8,11,18]

Obturation

A complication after the root canal therapy occurs as the result of over instrumentation or under instrumentation leading to extrusion of endodontic obturation materials or the obturation which is short of the apex, respectively. Extruded endodontic materials used may remain asymptomatic; others might lead to chronic sinusitis because of invasion by highly virulent microorganisms from oral cavity into the sinus. Symptoms can be systemic and local, which differs in every patient. Orbital pain and headaches have been found as a result from pain caused by the local compression of obturation material in many cases.[8,9,19,20]

Roots with open or wide apices can become potentially dangerous, when vertical condensation of root filling material is used, especially using injection type of thermoplastic gutta-percha or the paste filling method with a lentulo spiral or needle.[8,9,19]

Accidental over extrusion of root canal filling materials, including zinc oxide-based sealer or filling material into the sinus can be the etiological factor for aspergillosis and are considered to be the growth factor for the same.[8,9] It is generally accepted that prompt surgical intervention to remove foreign body is recommended to prevent squeal of acute and chronic sinusitis or mucosal cyst formation.[8]

Instrument Fracture

When an instrument fractures in the root canal system, it will compromise and limits the chemo-mechanical cleansing, shaping, working length control and root canal filling, resulting in reduced success rate of the endodontic treatment procedure.[21,22]

In a vital pulpectomy, the canal is considered virtually sterile, the objective of treatment is to remove all pulp tissue, shape, disinfect and fill the canal, sealing the access to prevent recontamination.[1,8] If the instrument fractures and is within in the canal apices during the shaping process, attempts are supposed to be made to remove or bypass based on the clinical situation; however, the presence of the retained fragment will not have any influence on the prognosis.[21]

When the fracture occurs in an infected canal, resulting in remnants of necrosed pulp tissue and areas inaccessible to further instrumentation and irrigation. This can further lead to failure by increase in the residual infection extending through the tooth into the sinus, ultimately to inflammation or infection of the maxillary sinus.[21-23]

Whenever the instrument fractures beyond the apex of the tooth both in vital and infected tooth, acts to carry the microorganisms from the oral cavity through the canal to the maxillary sinus. It can act as a foreign body and can stimulate an adverse reaction for the same.[9] The debris or the necrotic tissue carried through the fractured fragment or the file to the maxillary sinus can also be the cause of aspergillosis. Synergistic to the foreign-body reaction, it can also cause sinusitis or the inflammation of the maxillary sinus.[8,9,19]

Missed Canals

Maxillary molars are the teeth that possess varying number of roots, with different shapes and formations that is why the internal anatomy of these is variable.[8,24] The incompetence or the inability of the clinician to treat all the canals is one of the major reason resulting in endodontic treatment failure with reoccurrence of signs and symptoms in the periradicular region relating to the maxillary sinus floor.[8,19] In the maxillary molars, 93% of all missed canals were identified in the mesiobuccal root. One of the most likely causes of persistence or development of periradicular disease in maxillary molar is to locate, clean, shape, and obturate additional canal system in the mesiobuccal root of maxillary molars. Failure to locate the MB2 Canal has led to a significant drop in the long-term prognosis of the tooth with the progression of periapical or periradicular inflammation leading to periapical osteoperiostitis and periapical mucositis.[6,8,19,24]

Diagnosis of Maxillary Sinusitis of Endodontic Origin

A comprehensive clinical examination of the patient and the relevant history prevalent to medical and dental condition are helpful to rule out the endodontic origin of maxillary sinusitis. The diagnosis is mainly based on the recent past dental history involving the maxillary tooth and the complaint of the patient corresponding to the symptoms associated with maxillary sinusitis.

The symptoms of MSEO involves, feeling of fullness around the maxillary teeth or dull pain which is unilateral and during mastication or the functional movement. The patient may also complain of exacerbated pain with a change in position likely in lying down or bending, which increases the intracranial pressure from rapid blood flow. The affected sinus may be tender to palpation along with the teeth in relation can be sensitive to palpation and/or percussion. Nasal discharge considered to be a vital sign of sinus infection.[7,8,25,26]

The clinician should also identify that patients may experience a wide array of dental and sinonasal symptoms including no symptoms. The common sinonasal symptoms include congestion, rhinorrhea, retrorhinorrhea, facial pain, and foul odor.[8,27] Typical endodontic symptoms such as thermal pain, swelling and/or draining intraoral sinus tract are often absent. As the periapical infection drains into the sinus via fistula, periapical tenderness might be absent. These may not be obvious, as multirooted teeth or the premolars and molars have the potential for both sinus and intraoral presentation.[8,28]

Diagnosis using radiographic examination of maxillary sinus using periapical, occlusal, panaromic, and facial views can be made.[7] Panaromic radiography provides a wide field of vision with respect to sinus floor and its anatomical relation with the

tooth roots and the details of periapical lesions if any. Careful detailing of the radiograph to identify any periapical lesion that may have perforated the maxillary sinus with thickening of maxillary sinus floor or the mucosal membrane should be noted.[7,8,10]

Most of the time conventional radiographs due to overlapping or the magnification does not consistently reveal mucosal soft-tissue changes or air fluid levels in the sinus. Limited field cone-beam computed tomography imaging has been shown to significantly improve the ability to detect odontogenic sources for sinusitis.[7,8,29]

The presence of apical periodontitis adjacent to maxillary sinus cortical floor will often expand the sinus periosteum, displace it upward into the sinus and subsequently induce a periosteal reaction that continues to deposit a thin layer of new bone on the inner periphery of the periosteum as it expands. This reactive osteogenesis is termed periapical osteoperiostitis.[8,30]

Symptomatic or asymptomatic apical periodontitis in direct contact with or adjacent to the antral mucosa will typically produce a localized mucosal tissue edema termed as periapical mucositis.[8,9,30]

Periapical osteoperiostitis and periapical mucositis are the two unique radiographic findings. Both conditions can progress further to a partial or total sinus obstruction.[8]

Treatment

Successful management of MSEO, with infection of endodontic origin, is aimed on removing the foci of infection and preventing reinfection. The goal of treatment procedure in MSEO is to remove pathogenic microorganisms, their by-products and the pulpal debris from the infected root canal system that are causing the sinus infection.[8,31]

Appropriate treatment options include nonsurgical root canal therapy, periradicular surgery, intentional replantation, or extraction when indicated.[8,7]

Nonsurgical root canal therapy is indicated in under obturated canals, missed canals, and separated instruments within the apex.[8,32,33]

Periradicular surgery or surgical intervention to remove the extruded materials is recommended to prevent possible squeal of acute or chronic sinusitis or mucosal cyst formation.[8,23,34]

A sinus approach is classically achieved by open surgery through Caldwell-Luc sinusotomy that apart from foreign-body removal, aims at sinus clearance and drainage in the presence of serious mucosal disease.[34]

An alternative procedure to open surgical procedure is functional endoscopic sinus surgery, which is a reliable procedure that provides excellent visibility and allows for removal small foreign bodies with a limited incision under local anesthesia and reduced risk of infraorbital nerve damage.[35,36]

In case of an extrusion of irrigants, intracanal medicaments or the sealers, the patient should be reviewed by ENT specialists to rule out the complication in the sinus, based on the opinion and discussion a course of oral steroids, antibiotics, nasal steroids, and nasal decongestant can be advised with regular follow-up to check for the improvement or worsening of the condition. If there is worsening of the condition appropriate treatment plan to extract or to eliminate the cause of infection should be done.[8,11]

Conclusion

Thorough clinical and radiographical examinations are necessary to differentiate the origin of maxillary sinusitis. The symptoms of MSEO resembles the sinogenic sinusitis and the patients obtain the first primary care from the general physicians or the ENT professionals due to the absence of dental symptoms and the therapies given fail to resolve the condition due to endodontic involvement. Endodontists are trained and well equipped to diagnose and manage the condition. The careful endodontic procedure without any mishaps can reduce the occurrence or resolve the sinusitis associated with endodontic origin.

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Conflicts of interest

There are no conflicts of interest.

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