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Complications of Third Molar Surgery – A Literature Review

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Abstract

Third molar surgery is the most common procedure performed by the oral and maxillofacial surgeon. Sometimes unfortunately complications may happens during the third molar surgery which can badly affects the quality of patient's life. These complications can be prevented if planned surgical procedure is performed and proper surgical protocols are followed. General dental practitioner and as well as oral and maxillofacial surgeon should be familiar with possible complications that may happen and patient should also be made aware regarding these complications by the doctor too. This article gives the information about the incidence of specific complications, their prevention and management during third molar removal.

Keywords: Haemorrhage, Infection, Swelling.

Introduction

Surgical extraction of impacted third molar is one of the commonly performed procedure by the oral and maxillofacial surgeon.[1] Most third molar surgeries are

carried out without any complications. However, sometimes serious complications may happens that includes haemorrhage, infection, swelling, dry socket, paresthesia, temporomandibular joint injury and even fracture of mandible. These complications may have serious impact on the quality of life of patients. The complication rates of third molar surgery may vary from 2.6% to 30.9%, and all these complications are affected by various factors, like age of the patient, gender of the patient, systemic health, level of impaction, oral hygiene, smoking, experience of the surgeon and surgical technique used.[2]

Complications Associated with Third Molar Surgery

During Surgery

- Bleeding and haemorrhage
- Damage to adjacent teeth
- Displacement of the third molar
- Soft tissue injuries
- Nerve injuries
- Fracture of jaw bone
- Maxillary tuberosity fracture and oro-antral communication
- Swallowing and aspiration
- Breakage of tool

After Surgery

- Pain
- Swelling and surgical edema
- Trismus
- Infection
- Alveolar Osteitis (Dry socket)
- Wound dehiscence and delayed healing

Bleeding And Haemorrhage

Reported incidence of clinically significant haemorrhage in third molar surgery is 0.2% to 5.8%, and incidence of unexpected haemorrhage or prolonged haemorrhage up to 6-12 hours is 0.6% to 0.7%.

Bleeding can be either intraoperative (primary) or postoperative (secondary), and based on the cause it can be local or systemic.

Local causes of bleeding from impacted third molar surgery are soft tissue and vascular injury, poor design and poor manipulation surgical flaps, excessive trauma to bone, variations in the anatomy, proximity of the tooth to the neurovascular bundle, undiagnosed arteriovenous malformations.

Mandibular third molar at its distolingual aspect is highly vascularized, which may contains a accessory artery, which may bleed profusely if get injured.[3] Incidence of haemorrhage also increases with distal angulation of tooth, depth of impaction, and with the age of the patient, moreover mandibular third molar surgery is associated with excessive bleeding as compared to maxillary third molar surgery.

Systemic cause of bleeding for impacted third extractions are medications that affects the coagulation, coagulopathies (Von Willebrand disease, haemophilia A), liver diseases (affecting clotting factors), and hypertension.[2]

Local bleeding resulting from soft tissue and vessel injury can be controlled by application of moist gauze pack with adequate pressure for few minutes. However if the bleeding remains continues it may require additional suturing and other haemostatic agents which includes epinephrine 1:100000, topical thrombin, gelfoam, collaplug, tranexamic acid and bone wax. Vessel bleeding is best managed by its identification and ligation or cauterization.[4]

Patients who have known coagulopathies, underlying systemic causes and are on medications affecting coagulation, needs extensive preparation and

preoperative planning (eg, evaluation of INR, factors replacement, hematology consulation) prior to third molar surgery.

Damage To Adjacent Teeth

The reported rate of incidence for damage to adjacent teeth during third molar surgery is 0.3% to 0.4%.[5] Second molar teeth having caries, large restorations and crowns are often at high risk of damage during third molar surgery. Careful evaluation of entire operating field, proper bone removal, and correct use of instruments reduces the risk of trauma to the adjacent teeth.[6]

Displacement of Third Molars

Maxillary Third Molars

Maxillary third molars may get displaced into the infratemporal space or in the maxillary sinus during its surgical removal, it is reported in the literature but its incidence is unknown.

Maxillary third molars that are superiorly positioned and that have thin layer of bone separating it from infratemporal are at high risk for this complication. Its management includes surgical removal of the displaced tooth after locating it radiographically. Tooth can removed early or can be removed late after 3-4 weeks, delay in the removal of displaced tooth may result in fibrosis in the tissues around the tooth and stabilization of tooth which makes its removal easier.[7]

Displacement of maxillary third molar into maxillary sinus has also been reported. Improper use of the elevators and the excessive apical force during tooth removal are most common cause for it. Its management includes the retrieval of displaced tooth from the sinus. Initial attempts of tooth removal can be done by placing suction tip in the sinus through the sinus opening, if it fails to deliver the tooth, the sinus may be irrigated with normal saline and then suction tip is reapplied in the sinus, if this also fails then sinus can be approached with Caldwell-Luc surgery and then displaced tooth can be removed.[8]

Mandibular Third Molars

Mandibular third molars may get displaced into submandibular, sublingual pterygomandibular, and lateral pharyngeal spaces. Anatomical variations such as thin or dehisced lingual cortical plate, distolingual tooth angulation and excessive force during luxation are responsible factors for this complication.

It is managed by retrieving of the tooth from the fascial space. One author recommended the technique that operator should place his or her thumb underneath the inferior border of the mandible to direct the tooth back along the lingual surface of the mandible.[7] The lingual gingiva is then reflected up to the premolar region and the mylohyoid muscle is incised to access the submandibular space and tooth, then tooth is deliver out with curved haemostat, care should be taken for the lingual nerve protection, but this procedure is quite challenging because of haemorrhage, limited working area and further displacement of tooth which may happens because of blind probing and manipulation during the retrieval.[9]

Nerve Injuries

Both inferior alveolar and lingual nerve can be injured during mandibular third molar surgery. The reported incidence of IAN injury is 0.34% – 8.45% and for lingual nerve injury it is 0% - 23%.

Risk factors which are associated with IAN injury are increased depth of the impaction, proximity of the root apex to inferior alveolar canal, older age and technique of application of elevator. IAN injury can happen during the tooth elevation from the socket or may happens if roots may accidently pushed in the inferior alveolar canal. Clinically it represents as sensory disturbances of

jaw and lower lip may be as anesthesia, hypoesthesia, hyperesthesia or dysesthesia. 96% of the IAN injuries recover within 4-8 weeks after the injury, but sometimes injuries may be remain permanent and may represents as numbness or chronic neuropathic pain.

To prevent the IAN injury proper assessment of the nerve canal should be done, tooth should be sectioned before removal, coronectomy can also prevent IAN injury if tooth roots are closely related to nerve.

Risk factors for lingual nerve injury are lingual surgical approach, perforation of the lingual plate, superior position of the lingual nerve and lingual flap injury. Clinically it represents numbness in the anterior two third of the tongue along with the taste disturbances.[10]

The treatment modalities which are available for nerve injuries have unpredictable clinical outcomes. If neurotmesis (severe nerve injury) has happened, surgery (external neurolysis, direct suturing, autogenous vein graft bridging, bridging nerve defect) can be performed to repair the injured nerve. Nonsugical management includes vit. B complex, laser therapy (LLLT), corticosteroids and electrophoresis with nivalin.

Fractures of Jaw Bone

Mandibular bone fracture may happen as complication during third molar surgery with a very low incident rate of 0.0046% to 0.0075%. It may happens intraoperatively, immediate after the extraction or late after the extraction. Risk factors that may increase the chance of this complication includes increased age (above the age of 25 bone becomes brittle with age), male gender (high bitting force), distoangular impaction (requires more bone removal) mandibular atrophy, the presence of cyst or tumor and osteoporosis. Mandibular fracture during third molar extraction can be prevented by doing proper instrumentation and use of controlled force, instead of excessive bone removal tooth sectioning should be prioritized. Shifiting the patient on soft diet for up to 4 weeks after extraction could also preventive this complication to happen postoperatively.[11]

Maxillary Tuberosity Fracture and Oro Antral Communication

The incidence of maxillary tuberosity fracture during maxillary third molar surgery is 0.6% which is relatively low. The fracture of large bone of maxillary tuberosity can result in life-threatening haemorrhage because of close proximity of significant vessels. Deafness has also been reported in the literature which has occurred from disruption of the pterygoid hamulus and tensor veli palatine muscle, which collapsed the eustachian tube, restricted mandibular movements have been also seen because of disruption of pterygoid muscles and ligaments.

The etiological factors responsible for maxillary tuberosity fracture are large maxillary sinus with its extensions in the maxillary tuberosity or large projections of third molar roots apices in the sinus, fusion between third and second maxillary molar, curved roots, teeth with dental anomalies, tooth ankylosis, hypercemtosis, chronic periapical infection, old age of the patient, excessive force during tooth luxation by the operator.

If operator encounter a fractured tuberosity, then operator should stop the procedure and left the tooth in its place and the region should be stabilized with arch bar for 4-6 weeks if the tooth is non infected or asymptomatic, but if the tooth is infected or symptomatic then the extraction must be completed, and tooth should be separated from the tuberosity and roots should be sectioned properly with high speed rotary burs, and tuberosity should be assessed for viability

through attached periosteum and vascular supply. Buccal and palatal mucosal tears should be closed properly.[12]

Oroantral communications (OAC) are common surgical complications of dental procedures. In one study out of 465 maxillary third molar extractions, maxillary sinus perforation has happened in 13% of extractions, with maximum perforations happened in completely impacted teeth and least perforations in fully erupted teeth. Responsible factors for this complication are less bone thickness between tooth apex and the sinus floor, high positioning of the tooth, projection of tooth roots in the sinus cavity, higher age, periapical infections and intraoperative root fractures.

Its management is important because if OAC will remain untreated for longer time period for 4-5 weeks it changes into fistula known as oroantral fistula, which is an permanent epithelized communication between sinus and oral cavity, infection in sinus may also happen. OAC which is 2mm in diameter or smaller than that don't need any surgical intervention they close spontaneously by their own, but cases in which is communication is 3mm or of more diameter, requires surgical closure. Various surgical technique are there which can be used to close the OAC, these are buccal flaps, palatal flaps, tongue flaps, pedicled buccal fat pad, cheek flaps and gold foil can also be used to close OAC.[13,14]

Swallowing And Aspiration

All third molar surgery carries risk of tooth aspiration. Intravenous deep sedation compromise the protective airways reflex and is a risk factor for this complication. Proper use of oropharyngeal gauze prevents this complication.

Breakage of Tool

Sometimes breakage of the rotary bur may happens during the surgery, when it is used improperly. It may happens either during bone cutting or during tooth sectioning. It can be prevented by monitoring the integrity and state of the bur and the number of times the bur is used and when tooth sectioning is performed it should be done with light pressure with little lateral force.

If bur breakage and displacement occurs, its retrieval should be done as early as possible after locating it radiographically to avoid serious complications.[24]

Rarely needle breakage during the anesthesia may happens. This complications can have serious and life threatening consequences when anatomical structures are involved. The majority of cases happens due to sudden movement of the patient during the anesthesia administration. Changing the direction of the needle inside the tissues can also leads to needle breakage. Cases have been reported where the broken needle has been moved near to the important arteries of head and neck, to the skull base and to the external ear cannal. Patient may experience pain, tenderness, trismus, swelling, dysphagia or may remain asymptomatic, unilateral hearing loss may also have been reported.

To prevent this needle should not be bent, and when change in the direction is required, it should be completely removed from the tissues and enter again, also needle diameter, technique of handling the injection and patient should be taken into account. Long needles are considered more safer, because if they break part of them protrudes from the tissues and can be removed easily.[26-30]

Pain

Pain is one of the expected complication after third molar surgery. It sets immediately after the effect of local anesthesia wears off and reach at peak level after 6-12 hours of surgery. Pain that is reported in literature is usually of moderate intensity and usually last for 72

hours. Pain happens because of the inflammatory reaction that occurs due the physical injury of tissue. Inflammatory mediators are released from mast cells, vasculature and other cells causes pain at the site. Longer the duration of the surgery, more amount tissue damage happens which produces more mediators results in more pain, swelling and trismus.

This pain can be managed by the use of analgesics. Variety of analgesics are available to manage postoperative pain, NSAIDS including ibuprofen, paracetamol, diclofenac can be given for pain management and should be given before the effect of local anesthesia subsides. Administration of NSAIDS before surgery is very beneficial in pain management. Women may be more sensitive to postoperative pain and, may require more analgesics.[15]

Swelling And Surgical Edema

Postoperative swelling and edema are the expected complication after third molar surgery. It results from the accumulation of protein - rich exudates within the surrounding tissues, which is believed to be caused by prostaglandins and other inflammatory mediators released following surgery. Increased age, nature of impaction, gender of the patient, obesity and duration time of surgery are the risk factors for this complication. Its onset is gradual and maximum swelling occurs after 48 hours after the surgery, at the 4th day it starts to regress and it resolves completely after 7 days.[16]

It can be managed by application of ice packs over the area, ice causes vasoconstriction which reduces blood flow and thus reduces metabolism and edema. Ice application should not be for too long time as this may cause tissue death due to prolonged vasoconstriction and ischemia.[17]

Corticosteroids can also be given perioperatively to reduce swelling and edema. Corticosteroids acts by supressing the production of vasoactive substances such as prostaglandins and leukotrienes, thus fluid transduction and edema, the dose of the drug should be more than the cortisol released normally by the body. Dexamethasone 8 mg and Methyprednisolone 40 mg corresponds to 200 mg of cortisol. These can be given both by oral and IV route. Administration of 10 mg of Dexamethasone 1 hour before and 10 hours after the surgery significantly reduces the swelling postoperatively. Studies have also shown that submucosal administration of 4 mg dexamethasone 1 hour before surgery significantly reduces the postoperative swelling.[18]

Several authors have reported that sutures should not be tightly placed over the wound after surgery as it favours edema by creating a unidirectional valve that allows food fragments and fluids to reach the cavity but not leave easily, which can cause local infection, inflammation and edema, further placement of surgical drain at the site also reduces the postoperative edema.[19]

Osteotomy through the piezosurgery as compared to conventional techniques shown positive results.

Trismus

Trismus is also a normal and expected outcome of the third molar surgery. In this the jaw becomes stiff and mouth opening decreases and pain happens during mouth opening. Like edema, it usually reaches its peak on the 2nd day and resolves by own at the end of the week. It happens because of inflammation of the masticatory muscles, it may also happens if mouth is kept open for long time.

Use of steroids preoperatively helps in reducing the postoperative trismus. Mouth opening exercises postoperatively and pain killers along with muscle relaxants such as Chlorzoxazone and Thiocolchicoside are helpful in trismus management. LLLT (Low Level

Laser Therapy) has also been reported for showing positive results in trismus management [20]

Infection

Incidence rate of infection after third molar surgery is 0.8% - 10.1%. Infection may develop early or may develop late after surgical extraction. Age, degree of impaction, need for bone removal, presence of gingivitis or pericoronitis, systemic condition of the patient, use of antibiotics and experience of the surgeon are the risk factors for infection to happen. Odontogenic infections are typically of mixed variety with predominance of anaerobic microorganisms, streptococci are the single largest group of organisms which are present. Maxillary third molar infections may spreads to maxillary vestibule, buccal space, deep temporal space, or infratemporal fossa. Mandibular third molar infections may spreads to mandibular vestibule, buccal space, pterygomandibular space, submassetric space, submandibular space, or parapharyngeal space. Infection may also spread to retropharyngeal tissues and from this may go to mediastinum and can cause life threating problems.

The management of postoperative infection includes the proper surgical drainage and administration of appropriate antibiotics. Broad spectrum antibiotics are the first line of drugs that are given, for anaerobic coverage metronidazole can be added in the regimen.[21]

Alveolar Osteitis (Dry Socket)

It is a clinical condition in which severe pain happens at the extraction site and the bone becomes inflamed. It usually happens third day after the extraction. The incidence rate of dry socket following third molar extraction is 0.3% - 26%.

Etiology of alveolar osteitis is still poorly understood, although the fibrinolytic theory given by Birn is widely accepted. Birn proposed that infection or trauma during extraction stimulates the plasminogen to release which causes plasmin induced fibrinolysis. This fibrinolysis causes the dislodgment of clot that is formed after extraction results in dry socket. Another author Mamoun[22], suggests other hypothesis that high stress extractions puts the high compressive forces on the alveolar bone which surrounds the tooth, leading to necrosis of the osteoblasts that lines the socket. This necrosis of osteoblasts results in initiation of fibrinolytic activity that causes blood clot to dislodge. Some of the risk factors in the development of alveolar osteitis are prolonged traumatic extraction, increased age, female gender, use of oral contraceptives, pericoronitis and smoking.

It can be prevented by use of perioperative mouth wash, systemic antibiotics, postoperative warm saline rinses and by maintaining good oral hygiene. The treatment of dry socket is irrigation of socket with saline to remove food and other debris and placement of Zinc oxide – eugenol dressing, metronidazole dressing can also be placed, and commercially available dressing of Alveogyl can also be used. Irrigation with warm saline induces the fresh bleeding in the socket and forms a blood clot in the socket, PRF prepared from the patient's own blood can also be placed in the socket.[23,25]

Delayed Healing and Wound Dehiscence

Delay in the healing and dehiscence of the wound may happens if the medical condition of the patient is compromised, patient have osteoporosis or on corticosteroids, or if proper care is not taken by the patient.

Conclusion

Complications usually happens due to poor assessment of case, lack of knowledge of anatomy, overestimation of surgeon's potential, use of inappropriate tools and excessive and incorrect use of the force. Taking proper

medical history and studying the case appropriately along with preoperative radiographic evaluation and applying basic principles of surgical techniques reduces the appearance of complications, and also makes it easier to treat if they eventually occur.

REFERENCES

1. Osunde OD, Adebola RA, Omeje UK. Management of inflammatory complications in third molar surgery: A review of the literature. Afr Health Sci. 2011;11(3):530–537.
2. Azenha MR, Kato RB, Bueno RBL, Neto PJO, Ribeiro MC. Accidents and complications associated to third molar surgeries performed by dentistry students. Oral Maxillofac Surg. 2014 Dec;18(4):459-464.
3. Samuel Gbenga, Esezobor Peter Egbor. Mandibular third molar surgery: A review of common and uncommon complications. IBOM Medical Journal. 2021:14(4):130-138.
4. Susarla SM, Blaeser BF, Magalnick D. Third molar surgery and associated complications. Vol 15, Oral and Maxillofacial Surgery Clinics of North America. W.B. Saunders; 2003. p. 177-186.
5. Chiapaso M De Cicco L, Marrone G. Side effects and complications associated with third surgery. Oral Surgery, Oral Med Oral Pathol. 1993;76(4):412-420.
6. Wayland J. Complications In Impacted Third Molars. 1st Edition. John Wiley & Sons, Inc;2018.p.33-65.
7. Pogrel M. Complications of third molar surgery. Oral Maxillofac Surg Clin North Am 1990;2:441.
8. Patel M, Down K. Accidental displacement of impacted maxillary third molars. Br Dent J 1994;177:57.
9. Esen E, Aydogan LB, Akcali MC, Accidental displacement of an impacted mandibular third molar into the lateral pharyngeal space. J Oral Maxillofac Surg. 2000;58:96.
10. Osunde O, Saheeb B, Bassey G. Indications and risk factors for complications of third molar surgery in a Nigerian teaching hospital. Ann Med Health Sci Res. 2014;4(6):938-942.
11. Libersa P, Roze D, Cachart T, Libersa JC. Immediate and late mandibular fractures after third molar removal. J Oral Maxillofac Surg. 2002;60(2):163-165.
12. Chrcanovic BR, Freire-Maia B. Considerations of maxillary tuberosity fractures durings extraction of upper molar: a literature review. Dent Traumtol. 2011;279(5):393-398.
13. Flho ROV, giovanella F, Karsburg RM, Torriani MA. Oroantral communication closure using a pedicled buccal fat pad graft. Rev odontocienc. 2010;25(1):100-103.
14. Rothamel D, Wahl, Schwarz F, Becker J. Incidence and predictive factors for perforation for perforation of the maxillary antrum in operations to remove upper wisdom teeth: Prospective multicentric study. British Journal of Oral and Maxillofacial Surgery. 2007;45(5):387-391.
15. Bello SA, Adeyemo WL, Bamgbose BO. Effect of age, impaction types and operative time on inflammatory tissue reactions following third molar surgery. Head Face Med. 2011;7(1):1-8.
16. Ayaz H, Rehman AU, Din FU. Post-operative complications associated with impacted mandibular third molar removal. Pakistan Oral and Dental Journal. 2012;32(3):389-392.

17. Miloro M, Ghali GE, Larsen PE. Peterson's principles of oral and maxillofacial surgery. Inc Hamilton, Second Edition, 2004.
18. Darawade DA, kumar S, Mehta R, Sharma AR. In search of a better option: Dexamethasone versus methylprednisolone in third molar surgery. J Int Oral Health. 2014;6(6):14-17.
19. Brabander EC, Cattaneo G. The effect of surgical drain together with a secondary closure technique on postoperative trismus, swelling and pain after mandibular 3rd molar surgery. Int J Oral Maxillofac Surg. 1998;17(2):119-121.
20. Kasapolu E, Brki A, Gurkan-Kseolu. Complications following surgery of impacted teeth and their management. A textbook of advanced oral and maxillofacial surgery. 2013.p.4-25.
21. Al-Asfour A. Postoperative infection after surgical removal of impacted mandibular third molar: An analysis of 110 consecutive procedures. Med Princ Pr. 2009;18:48-52.
22. Mamoun J. Dry socket etiology, diagnosis, and clinical treatment techniques. J Korean Assoc Oral Maxillofac Surg. 2018;44(2):52-58.
23. Figueiredo R, Valmaseda-Castellon E, Berini-Aytes L. Incidence and clinical features of delayed-onset infections after extraction of third molars. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2005;99(3):265-269.
24. Kuncai Li, Bingqing Xie, Junliang Chen. Breakage and displacement of the high-speed hand-piece bur during impacted mandibular third molar extraction: three cases. BMC Oral Health. 2022;22:2253-2258.
25. Caso A, Hung LK, Beirne OR. Prevention of alveolar osteitis with chlorhexidine: a meta-analytic review. Oral Med Oral Pathol Oral Radiol Endod. 2005;99(2):52-58.
26. Stephan Acham , Astrid Truschnegg , Petra Rugani. Needle fracture as a complication of dental local anesthesia: recommendations for prevention and a comprehensive treatment algorithm based on literature from the past four decades Clin Oral Investig 2019;23(3):1109-1119.
27. M Anthony Pogrel. Broken local anesthetic needles: a case series of 16 patients, with recommendations J Am Dent Assoc. 2009;140(12):1517-1522.
28. Dojcinovic , M Hugentobler, M Richter. Needle breakage: a rare and potentially dangerous complication during local anaesthesia. Rev Stomatol Chir Maxillofac. 2007;108(3):222-224.
29. Stephan Acham, Astrid Truschnegg, Petra Rugani. Needle fracture as a complication of dental local anesthesia: recommendations for prevention and a comprehensive treatment algorithm based on literature from the past four decades. Journal of Morphological Sciences. 2010; 27(2):98-101.
30. Leandro Ribeiro , Sara Ramalho , Sandra Gerós. Needle in the external auditory canal: an unusual complication of inferior alveolar nerve block. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014;117(6):436-437.