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Comparison Between Efficacy of Turbine Handpiece vs Conventional Motor Handpiece in Surgical Removal of Impacted Third Molar: A Review

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Abstract-- Lower third molar extraction is one of the most common surgical procedure performed in oral surgery but despite the surgical skills and expertise, complications are likely. These can be pain,

swelling, bleeding, infection, fracture of adjacent tooth and nerve damage et cetera. One of the most essential armamentarium necessary for removal of impacted third molar is a handpiece with a bur used for removal of bone surrounding the tooth or odontectomy. This is usually done using a straight motor driven handpiece rotating at an approximate speed of 30,000 RPM. However, because of the low speed and torque the time taken in extraction can increase significantly making the procedure hectic and fatiguing for the patient as well as the surgeon. Air turbine handpiece is a precision device which can be used for removal of tooth tissue with reasonably less pressure, heat or vibration thus making the cutting facile, less demanding and less time consuming. However, the fear of subcutaneous emphysema associated with its use due to expulsion of air from the air turbine limits its use. Although rare, iatrogenic subcutaneous emphysema can have grave and potentially life-threatening consequences. This review aims to compare the efficiency and the complications associated with the use of air turbine handpiece in comparison to conventional motor driven hand piece in the removal of impacted third molars.

Keywords---turbine handpiece, conventional motor handpiece, surgical removal, impacted third molar.

Introduction

Third molar surgery is among the commonest procedures performed in oral and maxillofacial surgery offices.[1] However, this procedure requires does require dextrous planning and surgical skills. The reported frequencies of complications after third molar removal are reported between 2.6 percent and 30.9 percent.[2] Complications observed during or after lower third molar removal may include pain, trismus, alveolar osteitis swelling, bleeding, infection, and inferior alveolar or lingual nerve damage.[1] One of the most essential armamentarium necessary for removal of this tooth is a handpiece with a bur used for removal of bone surrounding the tooth or odontectomy as and when indicated. Most surgeons use a straight Micromotor handpiece that uses a motor as the driving force for the removal of impacted third molar. The conventional micromotor handpieces, runs at a speed of approximately 30,000 rotations per minute [3] in comparison to the air driven turbine handpiece that rotates at 2 lakh to 8 lakh rotations per minute (R.P.M).[4] Though being an efficient tool in exodontia, conventional micromotor handpieces have low torque and slow speed thus increasing the cutting time and making the procedure lengthy, tiring and stressful for the patient as well as the operator. Slow speed handpieces also result in heat, pressure and vibration generation.[4] The air turbine handpiece is a precision device which can be used for removal of tooth tissue with reasonably less pressure, heat or vibration thus making the cutting facile and less demanding. As it works on a very high speed it requires less time and has higher cutting efficiency. Air-driven high speed handpieces, also called turbines, are a comparatively smaller in head height, lighter in weight, and easier to handle. This renders improved accessibility, reduced user fatigue and in some cases, a more comfortable user experience, especially in busy offices where the hand piece is used

frequently. [5,6,]Also, The high speed the vibrations produced by it are perceived comparatively less uncomfortable by the patient. [7] Many dentists also report that they can feel what they are doing more easily when using an air-driven handpiece, because there is a speed reduction and a change of the frequency, so the dentist “hear” the contact of the bur to the tooth. This results in an extra sensitive work process. But, the air turbine expels air from the head while cutting, a major fear limiting it’s use in removal of impacted third molars is the potential complication of subcutaneous emphysema reported in literature. [8,9,10,11,12,13,14] Subcutaneous emphysema associated with dental extraction occurs when the air from the air turbine dental handpiece is pushed into the soft tissue through the reflected flap. This invades the adjacent tissues, leading to swelling, crepitus on palpation and occasionally spreading through the tissue spaces of the fascial planes. [13,14] This review aims to evaluate the current literature and compare the efficiency of Conventional motor driven hand piece versus turbine handpiece in the removal of impacted third molars.

Methods

A literature search was conducted using four databases searched systematically: PubMed, Cochrane Library, ScienceDirect and Google Scholar. Strings of MeSH and text search terms (“molar, third” OR “wisdom teeth”) AND (“post-operative” OR “post-op”) AND (“complications”) AND (Air-Turbine) AND (Micromotor) AND (Air rotor) were used in searching the databases. In addition specific post-operative complication keywords were searched: pain, swelling, oedema, trismus, infection, alveolar osteitis and dry socket. The review was limited to studies published from 1900 – 2021. From the search results, articles were selected for review based on their relevance to the research question. Abstracts were assessed and a full copy of the articles that met inclusion criteria was obtained. Reference sections of accepted articles were screened to identify further articles that may be relevant.

Lower third molar extraction and associated complications

Third molar extraction remains one of the most ubiquitous surgical procedures performed by oral and maxillofacial surgeons. In all surgical procedures, proper preoperative planning and the blending of surgical technique with surgical principles is integral to decrease the incidence of complications. Complications related to third molar extraction range from 4.6% to 30.9% [2,3]. They may occur intraoperatively or develop in the postoperative period. The four most common postoperative complications of third molar extraction reported in the literature are localized alveolar osteitis (AO), infection, bleeding, and paresthesia.[15] The procedure involves guttering of adjacent bone and tooth sectioning for which a handpiece with carbide bur is used. Controversies regarding the use of straight motor handpiece and air turbine handpiece still remain unanswered in literature. While some authors prefer the use of conventional motor handpieces because of fear of air emphysema, some suggest the use of air turbine superior in terms of post operative complications and time of procedure. Varieties of local and systemic factors that affect post-operative outcome in third molar surgery further complicate the analysis.

Air Turbine handpiece is a precision device for removal of tooth tissue. Although the air driven high speed handpiece rotates at a speed of around 2 lakh to 8 lakh r.p.m. It is also reported to be quieter, exhibits less vibration, and provides a defined cut with high concentricity. [16] The primary reported disadvantage is its low torque, which, together with its constant energy input (dependent on the air flow and pressure), causes load- dependent decreases in rotational rates, and even stalling. [17] The actual cutting speed and the rotational speed are two different aspects of high speed air turbine or airtor handpiece with the cutting speed usually being 30% less than the rotating speed. It is also known as Free Speed and Active Speed. With the high speed instruments the bur continues to rotate even after the clinician removes foot from the pedal that controls the air-water spray, this is called the Coast Speed which can increase the chances of tissue injury. Manufacturers have now come out with air rotors with vent to let out the excess air that is collected in the head of the handpiece so that the coast speed is markedly reduced and the bur comes to a halt at the earliest. [4]

Discussion and literature review

Third molar extraction is one of the routinely performed procedures in the field of dento-alveolar surgery, with a fairly low rate of postoperative complications. The complications associated with surgical extraction of lower third molars may occur intraoperatively or develop in the postoperative period. The most common postoperative complications of third molar extraction reported in the literature are localized alveolar osteitis (AO), infection, bleeding, and paresthesia. Others include damage to adjacent tooth, fracture of mandible, Iatrogenic displacement of maxillary third molars, aspiration and air emphysema associated with the use of air turbine. A lot of surgeons opine that air-turbine use(air rotor) can cause tissue emphysema and resultant marked swelling of the face thus advocating the use of micromotor handpiece.[8-14] Shih-Chia Yang [13] in 2006 presented a case of a woman who suffered from acute dyspnea and right cheek and neck swelling during molar extraction. The authors established that the use of a high-speed dental drill may introduce air into the soft tissue and lead to subcutaneous emphysema and pneumomediastinum. After a review of the literature, the authors found that subcutaneous emphysema and pneumomediastinum are rare complications secondary to dental extraction and dentists should be more aware of air leak during dental extraction. The first case of subcutaneous emphysema associated with a dental procedure was reported in 1900 [18] The pressurized air expelled from the air rotor may dissect through the cervical fascial planes into the mediastinum [19,20]. Also, the roots of the first, second, and third molars communicate directly with the sublingual and submandibular spaces. The sublingual space also communicates with the pterygomandibular, parapharyngeal, and retropharyngeal spaces. The retropharyngeal space is the main route of communication from the mouth to the mediastinum. [19,21]. The air that enters through the extraction wound can reach within these spaces to cause further complications. Iyer et al [22] conducted a study in two parts. In the first part of this study, the heat production during osteotomy drilling at three different speeds was investigated which determined that high-speed drilling produced the least heat when using 700 XL carbide burs. The second part studied the relationship between drill speed and healing by histologically examining the rate and quality of healing after drilling osteotomies at the three

speeds in the mandible at the period of 2, 4, and 6 weeks postoperatively. Histological findings showed that in the initial 6 weeks, the rate of healing and quality of new bone formation were higher after high-speed drilling than after low- or intermediate-speed drilling. These results, when compared with the results reported in the first part, observed a 4.3°C difference in heat production between the speeds. This seem to imply a relationship between heat production and healing for osteotomy drilling. Hall's [23] study for comparison of high speed turbine unit rotating at 200000 rpm to 350000 rpm with the use of chisel and low speed engine (10000- 20000 rpm), demonstrated the superiority of high speed engine, the time being shorter by 30-40 %, and trauma and post- operative pain being reduced by approximately 50%. He also mentioned that in low speed there was more pressure and vibration, leading to more trauma and more difficulty to patient and operator. These results revealed that the rise in temperature and the duration of rise in temperature decreased with speed and force, suggesting that drilling at high speed and with large load is more desirable than thought previously. Mazorow [24] studied the histological and radiographical effect of three methods for bone removal in oral surgical procedures. These were: automatic engine mallet (impactor), ultrasonic device and 200000rpm air turbine. He found no significant difference in the three groups at two days and two weeks, but after eight weeks, the drilling machine gave the best healing histologically and radiographically with greater density in the area in which bone was removed by air turbine. Corkery [25] in this review pointed that bone and tooth may be cut by burs or chisel depending on the convenience and training of surgeon but the use of high speed was more efficient and less traumatic than conventional speed. On the other hand, he did not recommend the use of air turbine in oral surgical procedures, because of the risk of surgical emphysema. Youdelman [26] valuated the use of high speed in oral surgery and concluded that trauma and post-operative pain were reduced by 50%, post-operative swelling was reduced slightly, operative time was reduced by 60% thus leading to less surgeon fatigue and effort. but he also pointed that the use of high speed air turbine was not without hazard. Bissell [27] compaired air turbine 300000rpm versus conventional 6500rpm handpiece on third molar odontectomies. The study sample included 30 patients with 60 impactions. The use of high speed reduced the operation time by 6.5 % and handpiece operation time by 20.4 %. Spatz, [28] conducted a comparative study between the conventional 12000 rpm and ultra speed turbine 300000 rpm on early reaction in bone in nine dogs. Sterile water spray was used as a coolant at the end of rotating burs. Specimens reviewed at 24 hour, 48 hour and 1 week post-operatively. Microscopic examination revealed a less initial inflammatory response, smoother cut edges, earlier and more rapid recovery in the surgical sites produced with ultra speed air turbine. Costicher along with the co-workers [29] studied the effects of high speed rotary instruments on bone repair in dogs. This study evaluated the microscopic and radiographic evidence of osseous response to ultra speed air turbine of 210000rpm with conventional speed rotary of 53000rpm. Radiographically, ultra speed air turbine with water coolant showed an advanced degree of healing than the other types of cuts. Microscopically, the heat effect was less and initial repair response was faster and more rapidly progressing in the cuts produced with ultra speed air turbine with water coolant. Kelly & Kay [30] in their study said that irrespective of the advantage of air turbine in removal of bone, it has the tendency to produce surgical emphysema and to drive infected particles of the teeth and bone into soft

tissues, Rafat [31] studied the effect of use conventional speed handpiece 40000 rpm, air turbine 200000 rpm and automatic engine mallet in removal of impacted mandibular third molars and it's effect on post operative complications on 45 patients. He found air turbine to have a more pronounced post-operative swelling followed by automatic engine mallet then conventional speed handpiece. Post-operative trismus and pain was maximum in air turbine followed by automatic engine mallet then conventional speed handpiece. Kilpatrick [32] studied the use of air turbine in comparison with hand and motor driven mallets and stated that high speed had the advantage of reducing operation time by at least one third and had less post-operative sequelae. Baral.P [33] in his study titled "Use of Air-Turbine for Removal of Impacted Teeth" carried out a research to assess the effects of the use of air-turbine (air rotor) during the removal of impacted teeth in 121 cases over a period of 2 years. He concluded that the results were encouraging as no tissue emphysema causing swelling was seen in all cases. Zhao-zhong [34] did a study to investigate complications in extraction of impacted wisdom teeth whose root apex near to the inferior alveolar nerve(IAN) by using routine method(chisels),high speed turbine handpiece and piezosurgery device in 300 patients divided in groups of 100 each.The operation time, postoperative pain duration,dry socket and IAN injury were compared between each two groups. The authors concluded that compared with routine method, high speed turbine was superior in extraction of impacted wisdom teeth as it can shorten operation time and lessen postoperative complications.

Conclusion

There is insufficient evidence to determine the superiority of use of air turbine over micromotor handpiece or vice versa. Literature suggest that the use of air turbine can significantly reduce the time and effort of extraction which can be beneficial for both the patient as well as the surgeon. Air turbine cuts the bone and tooth with reasonably less pressure, heat or vibration thus making the cutting facile, less demanding. However, the risk of a serious complication such as air emphysema even if extremely rare cannot be ignored. Consequently, we are unable to resolute firm recommendations to surgeons over the use of either techniques for removal of mandibular third molars. It is uncertain that the use of air rotor cause air emphysema as may authors have not reported this complication in their respective studies. Varieties of local and systemic factors that affect post-operative outcome in third molar surgery further complicate the analysis. None of the studies included in this review were at low risk of bias and most have a small small sample size. As the quality of the studies varied, with most having flaws this could easily cause biased rates of complications. For these very reasons, we consider the available evidence to be uncertain. Future research with large sample size and more control may be able to provide dental surgeons and patients with clearer conclusions than those listed above.

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