Original Article

Post-surgical Complications in Mandibular Third Molar Surgical Extraction Using Motor-driven Straight Handpiece and Air-driven Contra-angled Handpiece – A Comparative Study

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Abstract

Background: One of the most essential and pivotal steps in surgical extraction is osteotomy or alveolar bone removal, for which several techniques are employed, for example, chisels and mallet, rotary instruments, lasers, and ultrasonic instruments. The air-driven contra-angled handpiece is a newer innovative and high precision device that can be routinely used for osteotomy of impacted third molars. **Aim:** The aim of the study was to compare the post-operative complications using conventional straight handpiece and air-driven contra-angled handpiece for surgical removal of mandibular third molars. **Materials and Methods:** Patients were randomly categorized into Group A using motor-driven straight handpiece and Group B using contra-angled air-driven handpiece. Operative time was recorded in both the groups. Parameters such as pain, swelling, and trismus were evaluated and compared between both the groups on pre-operative, 3rd and 7th post-operative days. **Results:** The mean operating time was 35.67 min in Group A and 28.20 min in Group B which was statistically significant ($P < 0.05$). Furthermore, there was statistically significance difference ($P < 0.05$) in the levels of pain, trismus, and swelling on 3rd and 7th post-operative days. **Conclusion:** Post-surgical complications and intraoperative time taken were markedly reduced in air-driven contra-angled handpiece group when compared to conventional handpiece group.

Keywords: Mandibular third molars, Osteotomy, Post-surgical complications, Surgical extraction.

Introduction

The most common oral surgical procedure in oral and maxillofacial surgery is the surgical extraction of impacted mandibular third molars. Approximately 20% of the population has impacted teeth, among which mandibular third molars comprise the most. Surgical extraction of the mandibular third molar might vary from extremely easy to relatively difficult, and it further depends on numerous pre-operative parameters such as location, depth, angulations, and bone density.[1]

Cutting the alveolar bone, also known as osteotomy,[2] is an essential and pivotal step in surgical extraction. One should preferably remove the alveolar bone atraumatically by causing minimal thermal injury. To access the impacted tooth, several techniques are used for removing alveolar bone, namely, chisels with a mallet and rotary instruments. However, the above-mentioned techniques for alveolar bone removal cause injury to the bone and soft tissues, resulting in post-surgical complications such as pain, trismus, swelling, bleeding, infection, nerve injuries, and alveolar osteitis.[3] The frequency of complications following third molar surgery constitutes around 2.6–30.9%.[4]

Post-operative complications such as edema, pain, and trismus are generally managed by medications such as corticosteroids, nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids, flap designs, speed of the handpiece, post-operative application of laser, cold therapy, drains at the surgical site, and physical therapy.[5] Modalities mentioned above have disadvantages such as prolonged usage of NSAIDS causes gastric irritation, long-term usage of corticosteroids causes interruption in the hypothalamic-pituitary-adrenal axis, flap design needs surgical

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skill, laser or cold therapy requires an additional expensive device, sutureless techniques result in delayed wound healing, rubber drains ensure infection, chances of the detachment of drain from its site, and prolonged use of drain in the wound itself leads to further delay in wound healing, physical therapy requires patient's compliance. Hence, this study focuses mainly on surgical technique using a high precision device for alveolar bone removal and its effects on post-operative outcome following disimpaction of third molars in comparison with conventional rotary instruments.

The air-driven contra-angled handpiece with Friction Grip FG 151L-Z Zekrya Bur is a newer innovative and high precision device that can be routinely (Figure 1) used for osteotomy of impacted teeth with high cutting efficiency, less pressure, heat, or vibration, thus making the cutting easy. Few studies compare post-operative complications such as edema, pain, and trismus between the air-driven handpiece and conventional handpiece. The purpose of this study was to compare the surgical outcome of the third molar surgery using conventional micromotor handpiece and air-driven contra-angled handpiece.

Materials and Methods

A randomized prospective and comparative study was performed in patients who require surgical extraction of impacted mandibular third molars with moderately difficult impactions according to the modified Pederson's index. Patients were randomly categorized into Group A and Group B of 15 subjects in each group.

Inclusion criteria are as follows

- Healthy patients (ASA1)
- Moderately difficult impactions according to the modified Pederson difficulty index.

Exclusion criteria are as follows

- Medically compromised patients
- Patients with acute infections
- Patients with oral submucous fibrosis
- Slight and very difficult impactions according to the modified Pederson difficulty index.

Procedure

Group A (with motor-driven straight handpiece) and Group B (with contra-angled air-driven handpiece) were compared in patients who reported to the Department of Oral (Figure 1) and Maxillofacial Surgery of GITAM Dental College (Figure 1) and Hospital, Visakhapatnam for disimpaction of the impacted lower third molars. The study was conducted after obtaining approval from Institutional Ethical Committee. Once the patients satisfied the inclusion criteria, impacted third lower molar surgical extraction was carried out under local anesthesia. Similar post-operative drugs such as analgesics and antibiotics were prescribed for both the groups. Parameters evaluated are trismus, pain, and swelling on pre-operative, 3rd and 7th post-operative days.

The operative time was evaluated by measuring[3] the time in minutes using a digital stopwatch from the initiation of the incision till the last suture placement, which was observed intraoperatively in both the groups. The pain was evaluated subjectively by the visual analog scale.[1] This scale combines pictures and numbers to allow pain to be rated by the patient. The faces range from smiling faces (Figure 2) to sad and crying faces. A numerical rating has been assigned to these faces, which ranges from 0 to10 in ascending order, proportionate to increase pain. The patient is instructed to rate their pain using an appropriate picture.

The mouth opening was noted by measuring[1] the distance between the incisal edges of maxillary and mandibular central incisors at maximum mouth opening by a divider (Figure 3). The swelling was measured[5] using a five-line and flexible plastic tape measure as follows:

- Line 1: From the posterior-most point on the tragus of ear to the lateral most (Figure 4) point on the lip commissure
- Line 2: From the posterior-most point on the tragus to the pogonium
- Line 3: From the lateral canthus of the eye to the posterior-most point on the tragus
- Line 4: From the inferior-most point of the angle of the mandible to the lateral canthus of the eye and
- Line 5: From the mid-point of the nasal bone to the inferior-most point on the angle of the mandible.

The pre-operative sum of all the five-line measurement was considered the baseline. The difference between each post-operative and the baseline measurements would give the changes in the facial swelling.

Method of statistical analysis

The data were collected on forms entered in MS-Excel and analyzed in SPSS V25. Descriptive statistics were represented with percentages and mean with standard deviation. Independent t-test and repeated analysis of variance were applied to find significance and compare the measurements of pain, trismus, swelling, and operative time between two groups. The results were averaged (mean ± standard deviation) for each group parameter. In all the tests, $P < 0.05$ was accepted as statistically significant.

Results and Findings

Parameters observed

Pain

Comparison of pain scores between Groups A and B is illustrated in Table 1 and Graph 1. The pre-operative mean pain score for Groups A and B was 3.07 and 2.73, respectively, which are taken as baseline.

On the 3rd post-operative day, the mean pain score for Groups A and B was 4.87 and 1.80, respectively. On the 7th post-operative day, the mean pain score for Groups A and B was 3.20 and 0.56, respectively. It can be inferred from the above data that the mean pain was significantly reduced ($P = 0.000$) on the

3rd and 7th post-operative day in Group B when compared to Group A. From the above result, it can be inferred that the patients in Group B (using air-driven contra-angled handpiece) had decreased pain when compared with Group A (using motor-driven straight handpiece) at 3rd and 7th post-operative days.

Trismus

Comparison of trismus between Groups A and B is illustrated in Table 2 and Graph 2. The pre-operative mean mouth opening for Groups A and B was 41.93 mm and 45.60 mm, respectively, which are taken as base line.

On the 3rd post-operative day, the average mouth opening for Groups A and B was 30.47 mm and 35.67 mm, respectively. On the 7th post-operative day, the average mouth opening for Groups A and B was 34.60 mm and 40.40 mm, respectively. When Groups A and B are compared for mouth opening, no statistical significance was seen on the 3rd post-operative day, but the 7th post-operative day shows statistical significance ($P = 0.040$).

From the above result, it can be inferred that the patients in Group B (using air-driven contra-angled handpiece) had less trismus (better mouth opening) when compared with Group A (using motor-driven straight handpiece) at 3rd and 7th post-operative days.

Swelling

Comparison of swelling between Groups A and B is illustrated in Table 3 and Graph 3.

The pre-operative mean swelling for Groups A and B was 11.58 cm and 11.38 cm, respectively, which are taken as baseline. On the 3rd post-operative day, the mean swelling for Groups A and B was 12.43 cm and 11.57 cm, respectively. On the 7th post-operative day, the mean swelling for Groups A and B was 12.00 cm and 11.07 cm, respectively. There is a remarkable reduction in swelling at the 3rd and 7th post-operative day in Group B when compared to Group A.

From the above result, it can be inferred that the patients in Group B (using air-driven contra-angled handpiece) had lesser swelling when compared with Group A (using motor-driven straight handpiece) at 3rd and 7thpost-operative days.

Operating time

Comparison of mean operating time between Groups A and B is illustrated in Table 4 and Graph 4.

A statistical significance ($P < 0.05$) was observed when mean values of time taken for surgical extraction of impacted third molar for Group A and Group B are 35.67 min and 28.20 min compared. It can be said from the above result that the operating time for surgical extraction of third molars is quicker with air-driven contra-angled handpiece than motor-driven straight handpiece. It can be established after the observations that the post-surgical complications such as pain, swelling, trismus, and operative time are less in air-driven contra-angled handpiece when compared with the motor-driven straight handpiece.

Table 1: Comparison of mean pain between Groups A and B at pre-operative, 3rd and 7th post-operative days

Pain	Group A		Group B		*P*-value
	Mean	SD	Mean	SD	
Pre-operative	3.07	0.26	2.73	0.80	0.135
Post 3 days	4.87	0.64	1.80	1.15	0.000*
Post 7 days	3.20	0.56	0.60	0.63	0.000*
P-value	0.000*		0.000*		

*Statistically significant

Table 2 Comparison of mean trismus between Groups A and B at pre-operative, 3rd and 7th post-operative days

Mouth opening (mm)	Group A		Group B		*P*-value
	Mean	SD	Mean	SD	
Pre-operative	41.93	4.35	45.60	6.12	0.07
Post 3 days	30.47	5.49	35.67	10.40	0.10
Post 7 days	34.60	6.19	40.40	8.40	0.040*
P-value	0.000*		0.000*		

*Statistically significant

Table 3: Comparison of mean swelling between Groups A and B at pre-operative, 3rd and 7th post-operative days

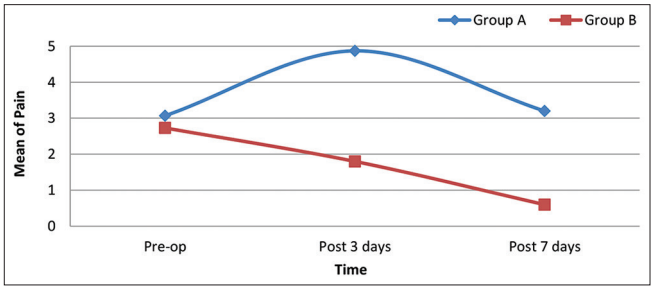
Swelling	Group A		Group B		*P*value
	Mean	SD	Mean	SD	
Pre-operative	11.58	0.67	11.38	0.48	0.341
Post 3 days	12.43	0.75	11.57	0.42	0.001*
Post 7 days	12.00	0.77	11.07	0.60	0.001*
P-value	0.000*		0.000*		

*Statistically significant

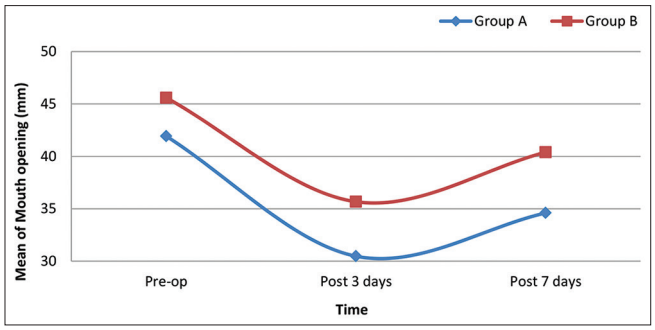
Table 4: Comparison of mean operating time between Groups A and B

Group	Operating time (minutes)		*P*-value
	Mean	SD	
Group A	35.67	7.988	0.035*
Group B	28.20	10.33	

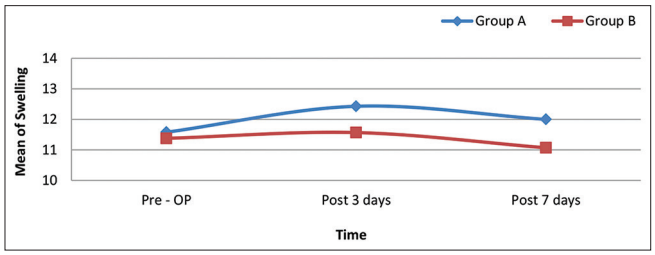
*Statistically significant



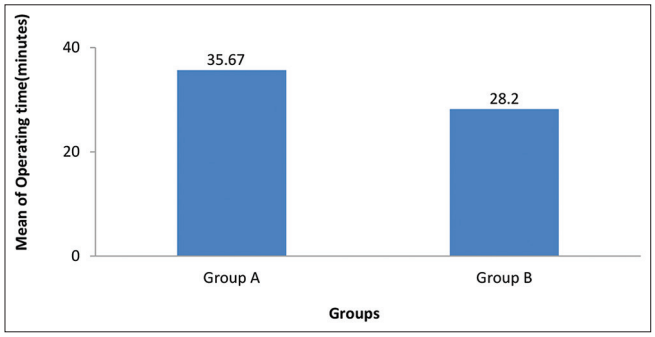
Graph 1: Comparison of mean pain between Groups A and B at pre-operative, 3rd and 7th post-operative days



Graph 2: Comparison of trismus between Groups A and B at pre-operative, 3rd and 7th post-operative days



Graph 3: Comparison of mean swelling between Groups A and B at pre-operative, 3rd and 7th post-operative days



Graph 4: Comparison of mean operating time between Groups A and B

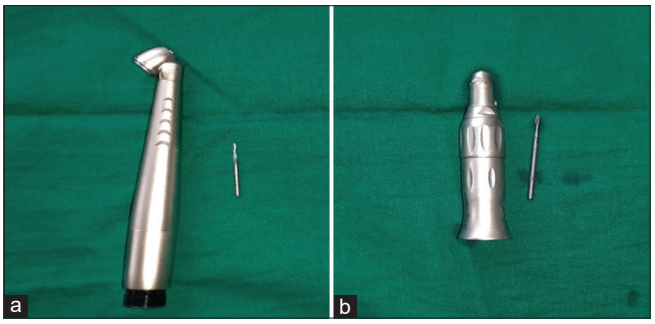


Figure 1: (a) Air-driven contra-angled handpiece, (b) Motor-driven straight handpiece

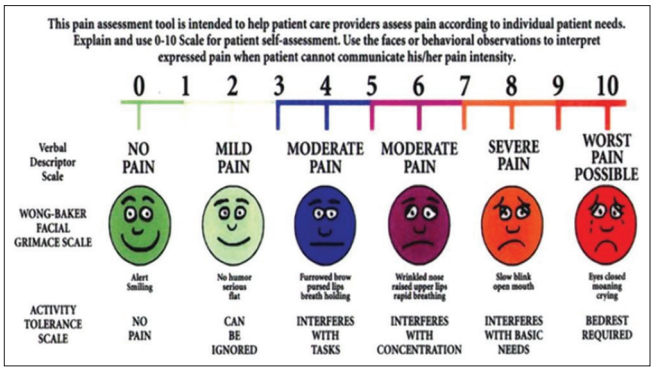


Figure 2: Visual analog scale

Figure 3: Measuring the inter incisal distance using divider

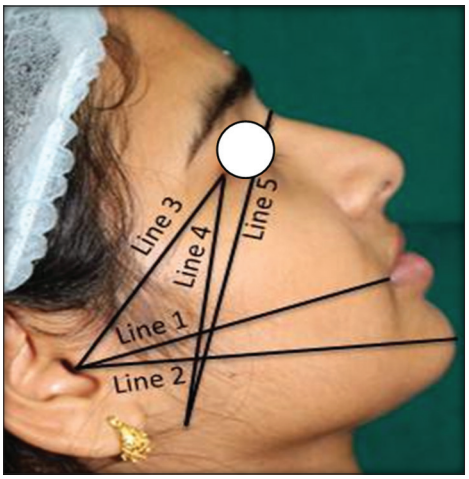


Figure 4: Five-line measurement of swelling

Discussion

In oral and maxillofacial surgery, impacted mandibular third molar surgery is the most frequently performed minor oral surgical procedures on a daily basis.[3] The presence of an impacted or partially impacted third molar in the mandible may lead to several consequences, which include regional pain, pericoronitis, distal caries, a periodontal pocket distal to mandibular second molar, odontogenic abscess, trismus, and development of follicular cysts, hence, they are indicated for surgical extraction.[6]

According to Al-Delayme *et al*.,[7] the post-surgical outcomes such as pain, edema, and trismus after mandibular third molar

removal depend on the angulations of impaction, depth, location, bone density,[8] and duration of operation.[9] According to a study by Santana-Santos *et al*.,[10] surgical parameters such as operating time duration and sectioning of the tooth were also associated with post-operative complications.

Srivastava *et al*.[1] stated that one of the crucial and critical steps in third molar extraction is bone cutting or osteotomy. The osteotomy of impacted third molars of the mandible produces a substantial degree of trauma to the adjacent structures (both bony and soft tissues) of the oral cavity, which remarkably results in a potentially significant inflammatory reaction which is the cause for usual post-operative surgical sequelae, namely, pain, edema, and difficulty in opening the mouth, that is, trismus due to spasm of the muscles.[3] The severity of postoperative responses is related to the "aggressiveness" of the procedure,[8] and the instrument being used for cutting bone can be high or low speed.[3] According to Rashad *et al*.,[11] the heat generated during osteotomy can potentially influence post-operative outcomes. Siroraj *et al*.[12] concluded that the thermal necrosis was inversely proportional to drill speed, influencing post-operative complications.

Many instruments used for osteotomy include chisel and mallet,[13] oscillating saw,[14] rotatory instruments using low-speed or high-speed[15] micromotor handpieces,[3] air turbines,[16] ultrasonic instruments such as piezosurgery,[1] Er: YAG laser,[6] and Co_2 lasers.[6] The ultrasonic instrument and chisel produced a rougher surface of bone, earliest bone formation, initial bone repair compared with conventional speed bur, according to Horton *et al*.[13] In complex extractions, Rullo *et al*.[17] concluded relatively marked pain in the group who underwent piezosurgery. Lasers have a few disadvantages, including their high cost and technique sensitivity.[6] Slow speed handpieces generate heat, pressure, and vibration and require constant energy input, leading to marginal osteonecrosis, damage to the adjoining tissues, and impair osseous regeneration and healing.[1]

According to Hobkirk and Rusiniak,[18] the effect of handpiece on the post-operative outcomes depends on several factors such as the speed of handpiece, time, rate, application of load, type, flow, the coolant temperature, the size, design, wear, and material of the used bur. The augmentation of the speed of the air turbine handpiece with a built-in coolant decreases vibration. Therefore, it becomes more convenient to both surgeon and patient as it decreases the pressure and time of surgery and consequently the amount of tissue trauma.

The air-driven contra-angled handpiece with Friction Grip FG 151L-Z Zekrya Bur is a newer innovative, high precision device with a 45° angulation at its shaft to reach the difficult areas of the mouth vent for escaping air, which lessens the risk of tissue emphysema caused by air embolism. It has fiber optic LED light and slot for saline irrigation which allows for greater visibility and the ability to evacuate debris in the operating field and reduces the need for an additional assistant for irrigation. This device could be used for surgical extraction with high cutting efficiency, commercially available from the Estherix by the name Ex 45 surgical handpiece.

After surgical disimpaction of the third molars, pain generally peaks after 3–5 h and continues for 2–3 days, gradually diminishing by day 7, similar in patients of both study groups.[19] The pain level was the highest on the 3rd post-operative day and diminished gradually, as seen on the 5th and 7th post-operative days in both the groups. Patients in Group B had less pain ($P < 0.001$) when compared with Group A at 3rd and 7th post-operative days after third molar surgery in the present study, which is in coherence with the study conducted by Youdelman.[20] According to Hall,[21] post-operative pain is reduced by 50% with a high-speed handpiece, similar to the present study. According to Rullo *et al*.,[17] the magnitude of pain can be related to the difficulty of a surgical procedure because they indicate the formation of prostaglandin E2, bradykinin, and other mediators of pain wherein the present study showed less post-operative pain in Group B, emphasizing the ease of surgery is better with contra-angled air-driven handpiece.

In accordance with a study done by Santana-Santos *et al*.,[10] where disimpaction was done using high-speed and low-speed handpieces, the pain was greater at 4–12 h when the operating time >31 min which is related to this study in which Group A used a conventional low-speed handpiece for surgical removal of impacted lower third molars. In this present study, the average pain was less in air-driven handpieces (high speed), contrary to the study conducted by Rullo *et al*.,[17] where the low-speed handpiece showed reduced pain. Agren[15] concluded no significant difference in pain scores between high- and low-speed handpieces, which contrasts with this present study.

The maximum swelling is commonly seen in the 2nd and 3rd post-operative days and lasts for 1 week following surgery.[22] Hence, the present study measured facial swelling on pre-operative, 3rd and 7th post-operative days. In the present study, the result showed that subjects in Group B had less swelling when compared with Group A at 3rd and 7th post-operative days ($P < 0.001$). According to Youdelmen *et al*.,[20] post-operative swelling was reduced slightly in all the patients with high-speed handpieces, similar to the present study. Postoperatively, the maximum swelling was on the first 24 h, and it began to subside gradually for both low- and high-speed handpieces. These findings were similar to the study done by Agren,[15] who stated that 74.5% of the measured facial edema was maximal on 24 h postoperatively, and 25.5% on by the 2nd post-operative day and facial edema was reduced by the 7th day postoperatively in nearly all patients. Kaban and Pogrel[23] stated that the swelling usually reached its peak by 48 h postoperatively and was usually resolved by the 5th –7th day, which is consistent with the present study showing the mean swelling value of 11.57 cm in Group B on 3rd post-operative day and 11.7 cm on 7th post-operative day indicating swelling was reduced from 3rd post-operative day to 7th post-operative day.

Trismus is the inability in opening the mouth, which markedly reduces in the first 72 h after third molar surgery, which may be attributed to pain and swelling.[2] In this present study, there was a marked improvement in the mouth opening on the 3rd and 7th post-operative days in Group B compared to Group A ($P < 0.001$), which is in coherence with the survey done by Agren.[15] According to a study conducted by Santana-Santos *et al*.,[10] operating time impact trismus which is related to this study where the operating time was relatively less, and there was also reduced trismus was observed in all the patients in Group B with contra-angled air-driven handpiece against the motor-driven straight handpiece (Group A).

The operating time for surgical extraction of third molars using air-driven contra-angled handpiece in Group B was reduced when compared with Group A using motor-driven straight handpiece. In contrast, Mistry *et al*.[3] demonstrated that post-operative outcomes were independent on the surgical time duration. Bissell[24] studied air turbine 300,000 rpm versus conventional 6500 rpm handpiece on third molar osteotomies. The use of high speed reduced the operation time by 6.5%, which is in coherence with the present study where operating time was drastically reduced when using an air-driven handpiece.

The present study results found that high-speed air-driven handpiece showed less operating time, which was related to the studies done by Youdelman[20] and Hall,[21] who demonstrated the superiority of the high-speed engine with the time being reduced by 30–40%.

The above results for each parameter indicate that the contra-angled air-driven surgical handpiece is more efficacious and less traumatic than a conventional motor-driven straight handpiece, which is consistent with the findings of Gulia *et al*.[16] According to Siroraj *et al*.,[12] alveolar bone removal or osteotomy using rotary handpieces generates heat of 50°C, resulting in thermal necrosis, which affects post-operative outcomes. Hence, in the present study, the air-driven contra-angled handpiece rotates at high speed with a self-irrigating system and vibrates effortlessly with no force applied, resulting in less heat and tissue trauma, lower post-operative morbidity, and improved post-operative morbidity patient quality of life.

According to Iyer *et al*.[25] and Siroraj *et al*.,[12] higher drill speed reduces temperature rise and operating time, which is related to the present study in Group B where contra-angled handpiece was used. Group A using conventional motor-driven straight handpiece showed more post-operative complications and has taken more time indicating that low-speed handpiece produces thermal necrosis and debris interferes with healing which is in coherence with the studies published by Romeo *et al*.[26] who stated that low drill speed directly resulted from the increased amount of debris which caused the rise in local temperature. This finding was also confirmed by Iyer *et al*.[25] who presented histological evidence of necrotic tissue in the low-speed group.

Further studies are recommended with larger sample size, including easy and very difficult impactions according to the modified Pederson's index. A split-mouth design with bilateral symmetrical impacted teeth is advised to reduce the bias further and achieve better standardization in the study. Future studies can also include these observations such as nerve injuries, tissue emphysema, surgeons experience with the device, patients quality of life, and operative time based on the difficulty of impactions and healing postoperatively. *In vitro* studies are to be carried out to investigate the cutting efficiency of high-speed contra-angled air-driven handpieces and can be correlated with clinical studies.

Conclusion

The air-driven contra-angled handpiece operates at high speeds (1.5 lakh RPM), which improves bone cutting efficiency and thereby reduces intra-operative time and post-surgical complications such as pain, trismus, and swelling. If the surgeon is proficient with this new/high-speed handpiece, this might be a boon for performing better osteotomies, as it reduces the surgeon's fatigue and improves the patient's overall post-operative well-being. The air-driven contra-angled handpiece may be an excellent alternative to a regularly used conventional motor-driven handpiece for disimpaction of impacted teeth.

References

1. Srivastava P, Shetty P, Shetty S. Comparison of surgical outcome after impacted third molar surgery using piezotome and a conventional rotary handpiece. Contemp Clin Dent 2018;9:318.
2. Patil C, Jadhav A, Rajanikanth K, Bhola N, Borle RM, Mishra A. Piezosurgery vs bur in impacted mandibular third molar surgery: Evaluation of postoperative sequelae. J Oral Biol Craniofac Res 2019;9:259-62.
3. Mistry F, Hegde N, Hegde M. Postsurgical consequences in lower third molar surgical extraction using micromotor and piezosurgery. Ann Maxillofac Surg 2016;6:251.
4. Bui CH, Seldin EB, Dodson TB. Types, frequencies, and risk factors for complications after third molar extraction. J Oral Maxillofac Surg 2003;61:1379-89.
5. Ristow O, Hohlweg-Majert B, Stürzenbaum SR, Kehl V, Koerdt S, Hahnefeld L, *et al*. Therapeutic elastic tape reduces morbidity after wisdom teeth removal-a clinical trial. Clin Oral Investig 2014;18:1205-12.
6. Civak T, Ustun T, Yilmaz HN, Gursoy B. Postoperative evaluation of Er: YAG laser, piezosurgery, and rotary systems used for osteotomy in mandibular third-molar extractions. J Craniomaxillofac Surg 2021;49:64-9.
7. Al-Delayme RM. Randomized clinical study comparing piezoelectric surgery with conventional rotatory osteotomy in mandibular third molars surgeries. Saudi Dent J 2021;33:11-21.
8. Goyal M, Marya K, Jhamb A, Chawla S, Sonoo PR, Singh V, *et al*. Comparative evaluation of surgical outcome after removal of impacted mandibular third molars using a piezotome or a conventional handpiece: A prospective study. Br J Oral Maxillofac Surg 2012;50:556-61.
9. Oikarinen K. Postoperative pain after mandibular third-molar surgery. Acta Odontol Scand 1991;49:7-13.
10. de Santana-Santos T, de Souza-Santos AP, Martins-Filho PR, da Silva LC, de Oliveira e Silva ED, Gomes AC. Prediction of postoperative facial swelling, pain and trismus following third molar surgery based on preoperative variables. Med Oral Patol Oral Cir Bucal 2013;18:e65-70.
11. Rashad A, Sadr-Eshkevari P, Heiland M, Smeets R, Hanken H, Gröbe A, *et al*. Intraosseous heat generation during sonic, ultrasonic and conventional osteotomy. J Craniomaxillofac Surg 2015;43:1072-7.

12. Siroraj AP, Giri GV, Ramkumar S, Narasimhan M. Extraction of impacted mandibular third molars-the effect of osteotomy at two speeds on peripheral bone: A histopathological analysis. Br J Oral Maxillofac Surg 2016;54:449-53.
13. Horton JE, Tarpley TM Jr., Wood LD. The healing of surgical defects in alveolar bone produced with ultrasonic instrumentation, chisel, and rotary bur. Oral Surg Oral Med Oral Pathol 1975;39:536-46.
14. Belgal PG, Ganta R. Piezosurgery in third molars a review of literature. J Surg Res 2018;1:53-7.
15. Agren E. High speed or conventional dental engines for the removal of bone in oral surgery: 1. A study of the reactions following the removal of bilateral impacted mandibular third molar. Acta Odontol Scand 1963;21:585-625.
16. Gulia DS, Kumar DS, Kashyap DR, Kour DK, Aasimah D, Thakker DR. Comparison between efficacy of turbine handpiece vs conventional motor handpiece in surgical removal of impacted third molar: A review. Turk J Physiother Rehabil 2021;32:1-5.
17. Rullo R, Addabbo F, Papaccio G, D'Aquino R, Festa VM. Piezoelectric device vs. conventional rotative instruments in impacted third molar surgery: Relationships between surgical difficulty and postoperative pain with histological evaluations. J Craniomaxillofac Surg 2013;41:e33-8.
18. Hobkirk JA, Rusiniak K, Investigation of variable factors in drilling bone. J Oral Surg 1977;35:968-73.
19. Aznar-Arasa L, Harutunian K, Figueiredo R, Valmaseda-Castellon E, Gay-Escoda C. Effect of preoperative ibuprofen on pain and swelling after lower third molar removal: A randomized controlled trial. Int J Oral Maxillofac Surg 2012;41:1005-9.
20. Youdelman SA. High speed and oral surgery. J Indian Dent Assoc 1969;41:127-8.
21. Hall RM. Surgical removal of impacted teeth using air turbine unit. J Oral Surg Anesth Hosp Dent Serv 1959;17:3-7.
22. Jüri K. In: Ailing CC, Helfrick JF, Alling RD, editors. Impacted Teeth. Philadelphia, PA: W. B. Saunders Co.; 1993.
23. Kaban LB, Pogrel MA. Complications in Oral and Maxillofacial Surgery. Philadelphia, PA: Saunders Company; 1997.
24. Bissell SL. Study of air turbine versus conventional handpiece on odontectomies. J Am Dent Assoc 1966;72:645-7.
25. Iyer S, Weiss C, Mehta A, Effects of drill speed on heat production and the rate and quality of bone formation in dental implant osteotomies. Part II: Relationship between drill speed and healing. Int J Prosthodont 1997;10:536-40.
26. Romeo U, Libotte F, Palaia G, Tenore G, Galanakis A, Annibali S. Is erbium: Yttrium-aluminum-garnet laser versus conventional rotary osteotomy better in the postoperative period for lower third molar surgery? Randomized split-mouth clinical study. J Oral Maxillofac Surg 2015;73:211-8.