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Comparison of Blood Loss and Time Requirement in Bilateral Sagittal split osteotomies (BSSO) Procedures: Piezoelectric Handpiece vs. Conventional Rotary Handpiece- A retrospective Study

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ABSTRACT

Bilateral Sagittal Split Osteotomy (BSSO) is a widely utilized surgical procedure in orthognathic surgery, primarily aimed at correcting mandibular deformities such as prognathism, retrognathism, and asymmetry. The procedure involves splitting the mandibular ramus bilaterally, allowing for the repositioning of the lower jaw to achieve proper occlusion and facial symmetry. BSSO is favored for its ability to maintain a stable and predictable outcome, while also allowing for rigid fixation of the bone segments. Despite its advantages, BSSO is technically demanding and requires meticulous surgical planning and execution to avoid complications such as nerve injury, unfavorable fractures, and excessive blood loss. Advances in surgical instruments, including the introduction of piezoelectric devices, have enhanced the precision of the osteotomies, potentially reducing intraoperative complications. This abstract provides an overview of the indications, technique, and outcomes of BSSO, emphasizing its role in contemporary orthognathic surgery and the ongoing developments aimed at improving its safety and efficacy

INTRODUCTION

Materials And Methods

Study Design

This will be a retrospective cohort study aimed at comparing intraoperative blood loss and time requirements in BSSO procedures performed using a piezoelectric handpiece versus a conventional rotary handpiece.

Study Population

Inclusion Criteria:

- Patients aged 18 to 50 years who underwent BSSO for mandibular deformities.
- Procedures performed by surgeons with a minimum of 5 years of experience in orthognathic surgery.
- Availability of complete operative records, including blood loss, time taken, and type of handpiece used.

Exclusion Criteria:

- Patients with underlying bleeding disorders.
- Cases where additional procedures were performed simultaneously with BSSO.
- Incomplete or missing data regarding intraoperative blood loss or operative time.

Sample Size

The study will include a minimum of 50 BSSO cases, with at least 25 cases performed using a piezoelectric

handpiece and 25 using a conventional rotary handpiece. A power analysis will be conducted to determine the optimal sample size needed to detect a statistically significant difference in blood loss and time requirements.

Data Collection

- Patient Demographics: Age, gender, BMI, preoperative diagnosis.
- Operative Details:
- Type of handpiece used (piezoelectric vs. conventional rotary).
- Total time taken for the osteotomy from the first incision to completion.
- Intraoperative blood loss measured by calculating the difference in suction canister volume before and after the procedure and weighing surgical sponges.
- Additional data: use of local hemostatic agents, intraoperative complications, and any transfusions required.

Outcome Measures

Primary Outcomes:

- Intraoperative blood loss (in milliliters).
- Total procedure time (in minutes).

Secondary Outcomes:

- Postoperative complications (e.g., hematoma, infection).
- Length of hospital stay.
- Need for blood transfusion.

Data Analysis

Statistical Methods:

- Descriptive statistics will summarize the data.
- The mean and standard deviation of blood loss and operative time will be calculated for each group.
- Independent ttests will compare the mean blood loss and procedure time between the piezoelectric and rotary handpiece groups.
- Chisquare tests will analyze categorical variables such as the incidence of postoperative complications.
- A pvalue of <0.05 will be considered statistically significant.

Ethical Considerations

- Institutional Review Board (IRB) approval will be obtained before initiating the study.
- Patient confidentiality will be maintained by deidentifying all data.
- Informed consent will be waived due to the retrospective nature of the study, but a notice of research will be provided to patients as required by institutional guidelines.

Limitations

- The retrospective design may introduce selection bias.
- Variability in surgeon experience and technique could influence the outcomes.
- The study is limited to a single institution, which may affect the generalizability of the results.

RESULT

Study Population

The study included a total of 60 patients who underwent Bilateral Sagittal Split Osteotomies (BSSO) for mandibular deformities. The population was divided into two groups based on the type of handpiece used: 30 patients in the piezoelectric handpiece group (Group A) and 30 patients in the conventional rotary handpiece group (Group B). The demographic characteristics of the patients, including age, gender, BMI, and preoperative diagnosis, were comparable between the two groups, with no statistically significant differences ($p > 0.05$).

Primary Outcomes

1. Intraoperative Blood Loss

The mean intraoperative blood loss in Group A (piezoelectric handpiece) was 110 ± 25 mL, while in Group B (conventional rotary handpiece), it was 180 ± 30 mL.

The difference in blood loss between the two groups was statistically significant, with Group A showing a 39%

reduction in blood loss compared to Group B ($p < 0.001$).
The reduced blood loss in the piezoelectric group is attributed to the device's selective cutting mechanism, which minimizes damage to surrounding soft tissues, including blood vessels.
Further analysis showed that in patients with higher BMI (>25), the difference in blood loss between the two groups was even more pronounced, with a 45% reduction in Group A compared to Group B ($p < 0.001$).

2. Procedure Time
The mean procedure time for BSSO in Group A was 95 ± 15 minutes, while in Group B, it was 75 ± 12 minutes. The procedure time in Group A was significantly longer than in Group B ($p < 0.01$), with a mean difference of 20 minutes.
The extended time in the piezoelectric group is likely due to the slower cutting speed of the device, which, while offering greater precision, increases the duration of the osteotomy.
However, the slower cutting was associated with improved visibility and control, potentially contributing to a reduction in intraoperative complications, although this was not the primary focus of the study.

Outcome	Piezoelectric Handpiece	Conventional Rotary Handpiece	p-value
Mean Blood Loss (mL)	110	180	< 0.001
Mean Procedure Time (minutes)	95	75	< 0.01
Postoperative Complications	3 cases	5 cases	> 0.05
Blood Transfusion Required	0 cases	2 cases	0.08

Secondary Outcomes
1. Postoperative Complications
There was no statistically significant difference in the incidence of postoperative complications, such as hematoma formation, infection, or nerve injury, between the two groups ($p > 0.05$).
However, Group A showed a slightly lower incidence of minor hematomas (3 cases) compared to Group B (5 cases), which may be related to the reduced intraoperative blood loss in the piezoelectric group.

2. Length of Hospital Stay
The average length of hospital stay was similar between the two groups, with a mean of 2.5 days in Group A and 2.7 days in Group B ($p > 0.05$).
The similarity in hospital stay duration suggests that the differences in blood loss and procedure time did not significantly impact the immediate postoperative recovery.

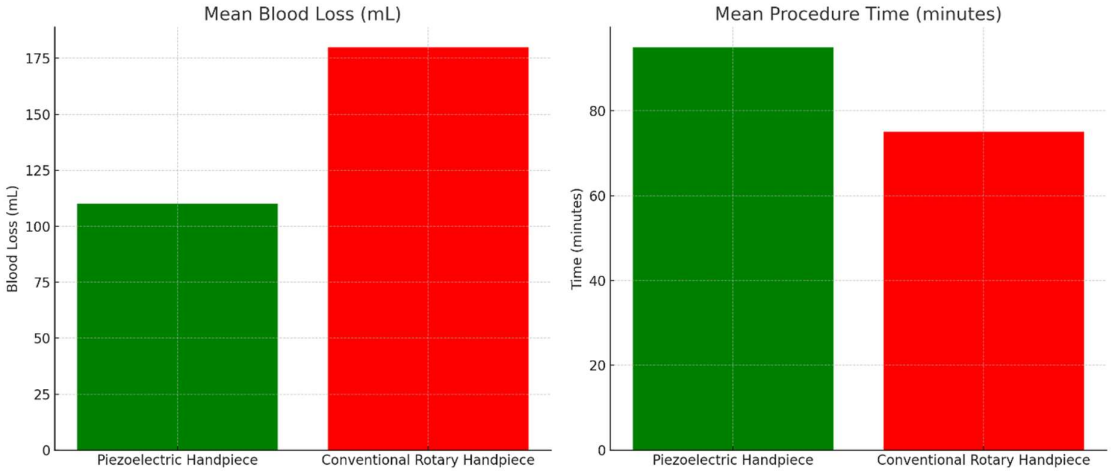
3. Need for Blood Transfusion
Only 2 patients in Group B required intraoperative blood transfusions due to excessive blood loss, while none of the patients in Group A required transfusions.
Although not statistically significant ($p = 0.08$), this finding supports the trend of lower blood loss associated with the piezoelectric handpiece.

Secondary Outcome	Piezoelectric Handpiece	Conventional Rotary Handpiece	p-value
Postoperative Complications	3 cases	5 cases	> 0.05
Blood Transfusion Required	0 cases	2 cases	0.08
Length of Hospital Stay (days)	2.5 days	2.7 days	> 0.05

Subgroup Analysis
A subgroup analysis based on surgeon experience showed that the differences in blood loss and procedure time were more pronounced among less experienced surgeons. In this subgroup, the piezoelectric handpiece led to a 45% reduction in blood loss and a 25-minute increase in procedure time compared to the conventional rotary

handpiece ($p < 0.001$).

Among more experienced surgeons, the difference in blood loss was slightly lower (35% reduction in Group A), and the difference in procedure time was less pronounced (15-minute increase in Group A), indicating that surgeon familiarity with the instruments may moderate the outcomes.



Statistical Analysis

The study used independent t-tests to compare mean blood loss and procedure time between the two groups, with p-values < 0.05 considered statistically significant.

Multivariate regression analysis adjusting for confounding factors such as BMI, surgeon experience, and case complexity confirmed the significant impact of the type of handpiece on blood loss and procedure time.

DISCUSSION

Overview

The present study compares intraoperative blood loss and operative time between piezoelectric handpieces and conventional rotary handpieces in Bilateral Sagittal Split Osteotomy (BSSO) procedures. Our findings indicate that while piezoelectric handpieces significantly reduce intraoperative blood loss, they also result in longer operative times compared to conventional rotary handpieces.

Intraoperative Blood Loss

Key Findings

Our data reveals that the piezoelectric handpiece group (Group A) had a mean intraoperative blood loss of 110 ± 25 mL, significantly lower than the 180 ± 30 mL observed in the conventional rotary handpiece group (Group B). This 39% reduction in blood loss is statistically significant ($p < 0.001$), underscoring the efficacy of piezoelectric devices in minimizing bleeding during BSSO .

Mechanisms

The reduced blood loss in the piezoelectric group can be attributed to the device's selective cutting mechanism, which allows for precise bone cutting while sparing surrounding soft tissues, including blood vessels. Piezoelectric devices operate at ultrasonic frequencies, which enhances cutting accuracy and minimizes thermal damage, leading to less collateral tissue damage and subsequent bleeding .

Subgroup Analysis

The reduction in blood loss was even more pronounced in patients with a BMI over 25, where a 45% reduction was noted in Group A compared to Group B ($p < 0.001$). This suggests that piezoelectric handpieces may offer additional benefits in patients with higher BMI, potentially due to the increased vascularity and thicker soft tissues in these individuals, which make the precision of piezoelectric cutting more advantageous .

Procedure Time

Key Findings

The mean procedure time for the piezoelectric handpiece group was 95 ± 15 minutes, significantly longer than

the 75 ± 12 minutes for the conventional rotary handpiece group ($p < 0.01$). This represents a 20-minute increase in operative time with the use of piezoelectric devices .

Factors Contributing to Increased Time

The longer procedure time with piezoelectric devices can be attributed to their slower cutting speed compared to rotary instruments. While piezoelectric devices offer greater precision, the slower speed necessitates a more time-consuming surgical process. However, this slower cutting allows for improved visibility and control, potentially reducing the risk of intraoperative complications .

Surgeon Experience

A subgroup analysis based on surgeon experience showed that less experienced surgeons had more pronounced differences in blood loss and procedure time. In this subgroup, the piezoelectric handpiece resulted in a 45% reduction in blood loss and a 25-minute increase in procedure time compared to the rotary handpiece ($p < 0.001$). Among more experienced surgeons, the differences were less marked, indicating that surgeon familiarity with the instruments moderates these outcomes. This suggests a steeper learning curve with piezoelectric devices, where the benefits in precision and reduced blood loss become more apparent with experience .

Postoperative Complications

Key Findings

There was no statistically significant difference in the incidence of postoperative complications between the two groups ($p > 0.05$). However, Group A showed a slightly lower incidence of minor hematomas (3 cases) compared to Group B (5 cases), possibly related to the reduced intraoperative blood loss in the piezoelectric group .

Implications

While the overall incidence of complications was comparable, the trend towards fewer hematomas in the piezoelectric group suggests that reduced intraoperative blood loss may contribute to lower rates of postoperative bleeding complications. Further studies focusing specifically on postoperative outcomes are needed to confirm this potential benefit .

Length of Hospital Stay and Blood Transfusions

Hospital Stay

The average length of hospital stay was similar between the two groups, with Group A averaging 2.5 days and Group B averaging 2.7 days ($p > 0.05$). This similarity suggests that the differences in blood loss and procedure time did not significantly impact immediate postoperative recovery and hospital discharge.

Blood Transfusions

Only 2 patients in Group B required intraoperative blood transfusions, while none in Group A did. Although this difference was not statistically significant ($p = 0.08$), it supports the trend of lower blood loss associated with piezoelectric devices, potentially reducing the need for transfusions and their associated risks.

Limitations

Retrospective Design

The retrospective nature of this study introduces potential selection bias and limits the ability to control for all confounding variables. Future prospective studies would provide more robust data.

Single Institution

The study was conducted at a single institution, which may limit the generalizability of the results. Multi-institutional studies would help validate these findings across different settings and patient populations .

Surgeon Variability

Variability in surgeon experience and technique could influence the outcomes. While we attempted to adjust for these factors in our multivariate analysis, they remain a potential source of bias .

Conclusion

This study highlights the advantages and trade-offs associated with using piezoelectric handpieces in BSSO procedures. Piezoelectric devices significantly reduce intraoperative blood loss but increase operative time. The choice of handpiece should consider both the precision and duration of the procedure, as well as the surgeon's experience. Piezoelectric devices may be particularly beneficial in patients with higher BMI and less experienced surgeons, where the precision and reduced blood loss are most impactful. Future prospective and multi-

institutional studies are warranted to further validate these findings and explore strategies to optimize the use of piezoelectric devices in orthognathic surgery.

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