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Original Research Article

# Estimation of blood loss in maxillofacial surgery

**Mohammed Idris Azeez[1], Dhanush C V[1,*], Suresh Menon[1], Etiah Sham[1], M Karthik Vishwas[1], Veerendra Kumar[1]**

[1] *Dept. of Oral and Maxillofacial Surgery, Vydehi Institute of Dental Sciences, Bengaluru, Karnataka, India*

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ABSTRACT

**Introduction:** The maintenance of the fluid balance of surgical patients is one of the most important responsibilities of the modern surgical team and the proper replacement of blood is perhaps one of the most important phases of this maintenance Although most surgeons and anaesthesiologists well appreciate this fact, they are often faced with the problem of accurately estimating blood loss in order to avoid under-replacement or over-replacement, both of which can have adverse effects in compromised patients.
**Materials and Methods:** A total number of 50 subjects, both males and females in the age group of 15-50 years who reported to our centre for major surgical procedures under maxillofacial surgery were included in the study. The study was conducted between September 2012 to November 2014.
**Results**: The intraoperative blood loss in various oral and maxillofacial surgeries ranged from 63.6 – 1343 ml. 15 had 101-200 ml, 5 patients had 301-500 ml and 12 had >500 ml of blood loss. The average intraoperative blood loss in various oral and maxillofacial surgeries was 343.3 ± 256.3 ml.
**Discussion**: The necessity of replacement of blood depends on the amount of blood loss peri-operatively. In order to have optimal effects, the blood must be administered as it is being lost and in proper amounts. In this study Gravimetric method was used for estimation of blood loss. The gravimetric method offers the surgical team a simple and practical means of estimating the amount of blood loss during the surgery. It will also help in having an analytical idea about the average blood loss and mean reduction in haemoglobin percentage in the various oral and maxillofacial surgeries which will be helpful in evaluating the postoperative necessity of blood transfusion.
**Conclusion:** Therefore there are very few instances where blood replacement is warranted in majority of the cases of that were operated.



## 1. Introduction

The maintenance of the fluid balance of surgical patients is one of the most important responsibilities of the modern surgical team and the proper replacement of blood is perhaps one of the most important phases of this maintenance. This is true not only because it is an excellent prophylactic measure against shock but also because it aids in decreasing postoperative morbidity. In order to obtain optimal effects, the lost blood must be replaced if necessary, at an appropriate time and in appropriate amount.

Purely subjective estimation by the surgical team has been shown to be often grossly inaccurate and at times the errors of personal judgment may reach dangerous levels, particularly in the compromised patient. In order to solve this problem several methods have been proposed, but of these the direct measurement as the operation progresses is the only practical and reliable means of determining blood loss.[1]

* *Corresponding author*.
*E-mail address*: drdhanush138@gmail.com (Dhanush C V).

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The importance of proper replacement of blood loss during and after operation has been recently re-emphasized by several clinical investigators who have demonstrated that although there is a compensatory increase in plasma volume and circulating plasma proteins following uncompensated blood loss in the well hydrated patient, there is no such compensatory increase in the red blood cells.[2]

There have been many assessments made of blood loss in surgery. Since 1955, many articles dealing with blood loss in oral surgery have been published. The methods have varied; gravimetric, volumetric, colorimetric, labelled red cells, blood volume measurement, electrolyte conductivity and serum specific gravity. Most popular have been the gravimetric and volumetric methods.[3]

## 2. Need for Study

A variety of studies have been carried out on evaluation of blood loss by various techniques in various surgical fields, but there are very less studies carried out on evaluating blood loss in the oral and maxillofacial region. Various studies have been carried out on control of hemorrhage in oral and maxillofacial surgeries, autologous blood transfusion and safe approaches and surgical techniques to gain access to maxillofacial region but insufficient information exists regarding blood loss in oral and maxillofacial surgeries. The essence of this study is therefore to estimate the blood loss in various oral and maxillofacial surgeries which may provide a guideline to the surgeon and anesthetist regarding the expected blood loss and need for blood.

## 3. Materials and Methods

A prospective study in a total number of 50 subjects, both males and females in the age group of 15-50 years who reported to our centre for major surgical procedures under maxillofacial surgery were included in the study. The study was conducted between September 2012 to November 2014.

### 3.1. Inclusion criteria

1. Subjects requiring major surgical procedures which included trauma, pathology and orthognathic surgery in the maxillofacial region under General Anesthesia with average operative time of less than 4 hours.
2. Subjects between the ages of 15-50 years.
3. Subjects in good health (ASA classification 1 or 2).

### 3.2. Exclusion criteria

1. Subjects with significant medical problems (ASA classification 3 or greater).
2. Subjects who have been diagnosed with a bleeding disorder or coagulation disorder previously.
3. Subjects with any hypertensive disorders.
4. Pregnancy.
5. Lack of informed consent.

## 4. Methodology

### 4.1. Preoperative assessment

At the screening visit each prospective subject underwent a complete medical history and physical examination to rule out any systemic disorders. Routine investigations including bleeding and coagulation profiles were done for each subject. The subjects were taken up for the surgery based on the inclusion and exclusion criteria and after taking the consent.

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Armamentarium:

1. Sponges and gauze (Figures 1 and 2).
2. A digital device to weigh the soaked sponges and gauzes (Figures 1 and 2).
3. Suction bottle with markings.
4. A monitor that instantaneously display the vitals.

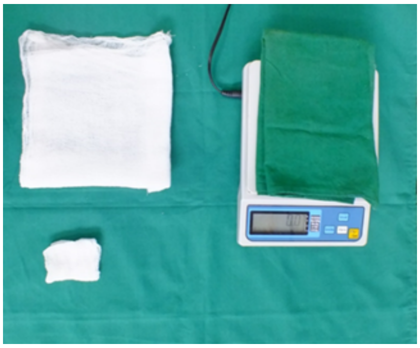

**Fig. 1:** Dry gauze piece and sponge and digital weighing machine

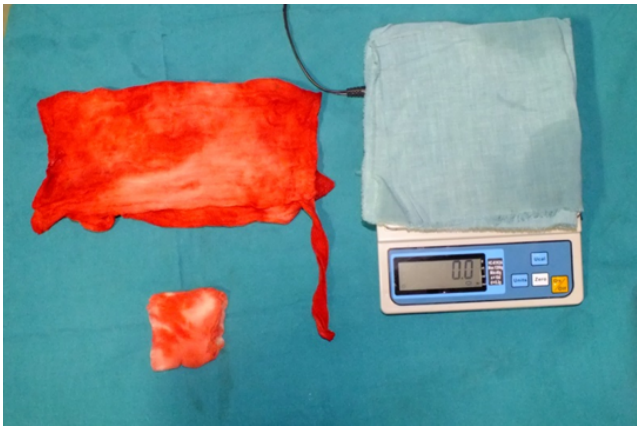

**Fig. 2:** Blood soaked gauze piece and sponge, digital weighing machine

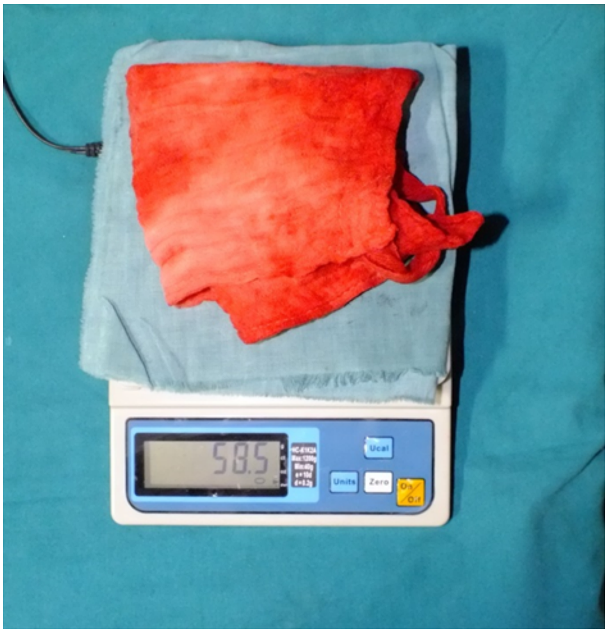


**Fig. 3:** Weighing of blood-soaked sponge

### *4.2. Technique*

In this study, Gravimetric technique was used for estimating blood loss which is based on the use of sponges, gauze packs employed for collecting blood during the operation and weighing them after use. A digital weighing device accurate to 0.1 gm was used. Preoperatively the weights of dry sponges, gauze packs were weighed. Immediately after use the sponges were weighed (Figure 3) so that evaporation from them doesn't become a critical factor. The complete gain in weight of sponges was treated as blood loss, each gram was considered as 1cc. The weight of dry sponges employed was subtracted from the total weight of the used sponges. If suction was employed, the amount of blood in the suction bottle was included. The amount of blood lost on the drapes, surgeon gowns and gloves was not measured because it is not practical to weigh these. Adding all this and subtracting from the fluids used intraoperatively, the approximate blood loss in the surgery was estimated.

Blood loss = (Total weight of wet gauze + Collection in suction) - (Total weight of dry gauze + Amount of saline used for irrigation).

## 5. Results

The estimation of blood loss was done using gravimetric method for 50 patients undergoing various oral and maxillofacial procedures under general anesthesia. The age of the patients ranged from 15 – 50 years. The mean age was 30.1+/- 10.7 years. Out of 50 patients, 44 patients (88%) were male and 6 patients (12%) were female.

The intraoperative blood loss in various oral and maxillofacial surgeries ranged from 63.6 – 1343 ml. 15 patients.

1. 26 patients of Maxillofacial trauma had less than 300 ml blood loss.
2. 1 patient of Implant infection had 101-200 ml blood loss.
3. 5 patients diagnosed of Maxillofacial Pathology had 100 – 200 ml blood loss.
4. 12 patients with TMJ ankylosis and Orthognathic surgery had 301-500 ml of blood loss.
5. 1 patient with post radiation fibrosis had >500 ml.

The average intraoperative blood loss in various oral and maxillofacial surgeries was 343.3 ± 256.3 ml.

Total of 26 cases were operated for trauma. Trauma cases were further classified based on the surgical approach into extraoral 7 (26.9%), intraoral 5 (19.2%) and combined 14 (53.8%). The average intraoperative blood loss in patients who were operated for trauma through extraoral, intraoral and combined approach was 376.2, 115.8 ml and 346.8 ml respectively. The patients who were operated through extraoral approach and combined approach had more blood loss than who were operated through intraoral approach.

Total of 16 cases were operated for benign pathology. Pathology cases were further divided based on treatment modality into enucleation (18.7%), excision (31.2%), resection (6.2%), excision with reconstruction (18.7%), resection with reconstruction (12.5%), secondary reconstruction (6.2%) and ligation of parotid Duct (6.2%). The average intraoperative blood loss in enucleation was 342.2 ml, excision was 303.8 ml, resection was 630 ml, excision with reconstruction was 331.6 ml, resection with reconstruction was 593.5 ml, secondary reconstruction was 426 ml and ligation of parotid duct was 146.8 ml.

Miscellaneous cases include TMJ ankylosis (3) for which gap arthroplasty was done and the average intraoperative blood loss was 413.3 ml, orthognathic (2) for which Bilateral Sagittal Split Osteotomy (BSSO) was done and the average intraoperative blood loss was 343 ml, post-operative infection (2) for which implant removal was done and average intraoperative blood loss was 96.2 ml and post radiation fibrosis (1) for which surgical release of fibrous bands with suprahyoid myotomy was done and the average intraoperative blood loss was 835.6 ml.

The preoperative hemoglobin percentage ranged from 9.9 – 16.5gm % (13.7±1.5) and the postoperative hemoglobin percentage ranged from 8.0 – 15.9gm % (12.6±1.8). The mean reduction in hemoglobin percentage in various oral and maxillofacial surgeries ranged from 0.48 - 1.88gm % (SD 0.25-0.90). The mean reduction in hemoglobin percentage in patients with Trauma, Pathology and Miscellaneous was 1.10gm % (SD 0.90), 1.25gm % (SD 0.73) and 1.15gm % (SD 0.64) respectively (P value =

0.860). The reduction of hemoglobin had a positive relation to the amount of blood loss (P value <0.01).

**Table 1:** Distribution of patients according to their age group

| Age (in Years) | No. | Percent |
|---|---|---|
| ≤ 20 | 10 | 20.0 |
| 21-30 | 23 | 46.0 |
| 31-40 | 7 | 14.0 |
| 41-50 | 10 | 20.0 |
| Mean ± SD | 30.1 ± 10.7 | |
| Range | 15-50 | |

**Table 2:** Distribution of patients according to the type of cases

| Type of Cases | No. | Percent |
|---|---|---|
| Trauma | 26 | 52.0 |
| Pathology | 16 | 32.0 |
| Miscellaneous | 8 | 16.0 |

## 6. Discussion

The hazard of surgical blood loss is a complex problem that is as old as surgery itself. Factors of preoperative blood volume and preoperative transfusion are included in the problem, as well as the more obvious factors of blood loss and blood replacement during and after surgery.[3]

Maintenance of circulating blood volume is thus one of the most important homeostatic mechanisms that the body must support. Poor blood supply to the tissues ultimately affects every cell in the body and organ dysfunction will quickly develop if tissue perfusion fails. Hemorrhagic shock is defined as a failure of adequate tissue perfusion resulting from a loss of circulating blood volume.[4]

Significant blood loss from any cause initiates a sequence of stress responses that are intended to preserve flow to vital organs and to signal cells to expend internal energy stores. Hemorrhagic shock reduces wall tension in the large intrathoracic arteries, which activates baroreceptors. Adrenergic reflexes that have neural and circulating hormonal components are also activated. Neural effects are immediate; hormonal changes may be rapid, but some time is needed for them to take full effect. The two major neural components are sympathetic fibres from the stellate ganglion, which stimulate the heart, and sympathetic fibres from regional ganglia, which cause peripheral arterial vasoconstriction.[4]

Not all hemorrhagic shock is as obvious, a change in arterial acid−base status will often precede any significant decrease in cardiac output with hemorrhage. The arterial and venous blood bicarbonate level and base deficit will decrease early in hemorrhage even if pH and blood pressure remain in the normal range.[5]

Distinguishing simple hemorrhage from hemorrhagic shock is possible by noting that when the base deficit becomes pathologically low, widespread tissue hypoperfusion may be suspected. Patients with tachycardia, a low base deficit, and low urine output should be suspected of having hemorrhagic shock.[5]

By measuring blood loss continuously, significant deficit can be recognized and replacement can be started even before the physical changes due to blood loss are manifested. The blood volume can then be kept within physiological limits of tolerance if the loss replacement balance is quantitatively maintained.[6] Although there is a compensatory increase in plasma volume following uncompensated blood loss, there is no increase in the number of red cells. Without blood transfusion the red cell volume does not return to normal for several weeks. This uncompensated red cell loss leads to reduction in the oxygen carrying capacity of the blood. This may result in varying degrees of hypoxia, which tend to prolong post-operative recovery and, in patients already possessing a diseased myocardium, may lead to cardiac and circulatory disturbances and possibly cardiac failure.[6]

The first recorded attempt to directly determine blood volume was made by Haller before 1854. His method, as quoted by Welcker, consisted of weighing blood obtained from bleeding two criminals to death. Using animals, Welcker in 1854 expanded this technic to include the washing out of blood vessels, mincing and washing tissues, and combining blood and washings to determine hemoglobin content. From his studies he concluded that mammals have blood equal to 1/13 the body weight. In 1856 Bischoff applied this method to two criminals and obtained the same value. Kieth, Rowntree, and Geraghty, in providing the above information, reviewed all indirect methods of blood volume determination up to 1915.[7]

Harjinder Sharma, Suman Arora et al. studied the effect of Tranexamic Acid Is Associated with Improved Operative Field in Orthognathic Surgery in 36 patients with a mean age of 23.67 years and concluded that Tranexamic acid improved surgical field visibility and reduced intraoperative blood loss when administered in conjunction with dexmedetomidine during orthognathic surgery under controlled hypotensive anesthesia.[8]

Michael Schwaiger and Jürgen Wallner studied that is there a hidden blood loss in orthognathic surgery and should it be considered. The aim of this prospective observational study was to investigate the parameter 'hidden blood loss' (HBL) in the context of orthognathic surgery, incorporating undetected bleeding volumes occurring intra- and postoperatively. 82 patients (male 33, female 49) were included in this study, of whom 41 underwent bimaxillary surgery and of whom 41 underwent Bilateral Sagittal Split Osteotomy (BSSO) and concluded that HBL is a valuable adjunct to record within the perioperative management of orthognathic surgery to further improve patient safety and postoperative outcomes.[9]

**Table 3:**

| Type of Surgery | Amount of Blood Loss (in ml) | | | |
|---|---|---|---|---|
| | n | Minimum | Maximum | Average |
| **Trauma (Approach)** | | | | |
| Extraoral | 7 | 63.6 | 506 | 376.2 |
| Intraoral | 5 | 70 | 158 | 115.8 |
| Combined | 14 | 72 | 1343 | 346.8 |
| **Total** | 26 | 63.6 | 1343.0 | 315.1 |
| **Pathology (Treatment Modality)** | | | | |
| Enucleation | 3 | 123 | 741.8 | 342.2 |
| Excision | 5 | 152 | 492 | 303.8 |
| Resection | 1 | - | - | 630 |
| Excision and Reconstruction | 3 | 230 | 408 | 331.6 |
| Resection and Reconstruction | 2 | 652 | 535 | 593.5 |
| Secondary Reconstruction | 1 | - | - | 426 |
| Ligation of parotid duct | 1 | - | - | 146.8 |
| Total | 16 | 123 | 741.8 | 370.6 |
| Miscellaneous | | | | |
| TMJ Ankylosis- Gap Arthroplasty | 3 | 351 | 540 | 443.3 |
| BSSO | 2 | 276 | 410 | 343 |
| Implant removal | 2 | 91 | 101.4 | 96.2 |
| Post radiation fibrosis- Release of fibrous bands | 1 | - | - | 835.6 |
| Total | 8 | 91 | 835.6 | 380.5 |

Mark E Thompson, Charles Saadeh studied whether epsilon-aminocaproic acid (EACA) load of 50 mg. kg−1 before skin incision, and infusion of 25 mg/kg until skin closure during cranial vault reconstruction were associated with decreased estimated blood loss and transfusion requirements. The study was done in 45 consecutive infants and children undergoing primary craniosynostosis surgery at Covenant Children's Hospital during years 2010-2014. They found statistical significance in blood loss and transfusion requirements in surgeries of the shortest duration.[10]

Babatunde O. Akinbami assessed the amount of blood loss and duration of surgery. A total of 139 patients were analyzed, out of which 75 (54.0%) were males and 64 (46.0%) were females. Pre- and postoperative haematocrit values, number of units of whole blood requested, cross-matched, and used, procedure, amount of blood loss, and duration of surgery were recorded. They concluded that multiple factors may be responsible for blood loss during maxillofacial operations, but much still has to do with the physiological status and normal clotting mechanisms of the patients, nature of the lesions, and the use of anaesthetic and surgical control measures.

Aliabadi E et al assessed the intraoperative blood loss of patients with maxillofacial bone fracture surgical intervention and to assess their need for blood transfusion. In this retrospective study, intraoperative blood loss of 206 patients with facial bone fractures, who underwent surgery between 2017 and 2018, was retrieved. The average amount of intraoperative blood loss was 77.6 ml, and none of the patients required a blood transfusion during the operation in this group of patients. They concluded that preparation for blood transfusion in patients with maxillofacial traumatic bone fracture requiring surgery is uncommon if patients have no systemic disease or specific blood dyscrasias preoperatively.[11]

## 7. Conclusion

Blood loss during surgeries is one of the major problems faced by the anesthetist and the surgeon. The replacement of blood loss during surgical operations is a very essential part of the operative procedure as it decreases the postoperative morbidity. The necessity of replacement of blood depends on the amount of blood loss peri-operatively. In order to have optimal effects the blood must be administered as it is being lost and in proper amounts. Hence estimation of blood loss is essential to determine the necessity of replacement. Various methods for estimation of blood loss have been adopted by different authors. In this study Gravimetric method was used for estimation of blood loss.

50 patients undergoing major surgical procedure in maxillofacial region under general anesthesia were included in this study. Majority of cases operated were trauma followed by pathologies and miscellaneous. The blood loss in various oral and maxillofacial surgeries ranged from 63.6 – 1343 ml (343±256.3). The average intraoperative blood loss in patients with Trauma, Pathology and Miscellaneous was 318.6 ml, 370.6 ml and 380.5 ml respectively. The mean

reduction in hemoglobin percentage in various oral and maxillofacial surgeries ranged from 0.48 - 1.88gm % (SD 0.25-0.90). The mean reduction in hemoglobin percentage in patients with Trauma, Pathology and Miscellaneous was 1.10gm % (SD 0.90), 1.25gm % (SD 0.73) and 1.15gm % (SD 0.64) respectively. Therefore there are very few instances where blood replacement is warranted in majority of the cases of that were operated.

## 8. Source of Funding

None.

## 9. Conflict of Interest

Source of Funding.

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## Author biography


**Mohammed Idris Azeez,** Senior Consultant

**Dhanush C V,** Consultant

**Suresh Menon,** Professor & HOD https://orcid.org/0000-0002-3384-0810

**Etiah Sham,** Professor

**M Karthik Vishwas,** Assistant Professor https://orcid.org/0000-0002-2459-7003

**Veerendra Kumar,** Associate Professor


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