Original Research Paper

Volume - 11 | Issue - 04 | April - 2021 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Dental Science

ASSESSMENT OF PULMONARY STATUS FOLLOWING INTERMAXILLARY FIXATION- A CLINICAL STUDY

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ABSTRACT ***Aim:*** The aim of the study was to determine the effect of intermaxillary fixation on pulmonary function.

Methods:133 patients comprising 107 males and 26 females with age ranging from 18 to 50 were taken up for study. The patients' Pulmonary Function Tests were done using spirometer to measure the necessary parameters before and after the application of intermaxillary fixation. The values obtained were also compared with 50 healthy volunteers.

Results: The results showed that there is a significant decrease in values of Pulmonary Function Test after the application of intermaxillary fixation.

Conclusion: Pulmonary status evaluation becomes necessary on account of the obstructive nature of intermaxillary fixation. This simple and routinely used procedure should be avoided in respiratory compromised patients with Pulmonary Function Test values lower than the predicted value.

KEYWORDS : Fracture, Intermaxillary fixation, Pulmonary function

INTRODUCTION

Despite advances in the treatment of maxillofacial fractures, the time-honored method of rigid connection of maxilla and mandible by intermaxillary fixation, a traditional treatment modality for complex fractures of middle third of face and mandible, still occupies a pertinent role in management arena. Closed method of fracture reduction by intermaxillary fixation was introduced in 1942 by Guglielmo Salicetti[1]. This simple method of closed reduction became well accepted by all pioneers from the pre antibiotic era. Since then several methods of intermaxillary fixation was developed by Gilmer T L[2], G V Black, E H Angle[3] and many others.

Intermaxillary fixation is still the commonest method of closed reduction for maxillomandibular fractures. It can be performed in Out-Patient basis under local anesthesia and is associated with less post operative complications. The economic burden on the patient is less with the closed method of fracture management. Hence this traditional method of intermaxillary fixation is still continued in the underdeveloped and developing countries for management of maxillofacial fracture [4,5]. There are several factors that preclude its usage, despite the high versatility, like history of psychiatric illness, seizure disorders, obstructive respiratory diseases and mentally retarded states.

Intermaxillary fixation is also associated with several demerits. These include difficulty in maintaining proper oral hygiene, restriction of solid diet, leading to weight loss and metabolic disturbances and airway obstruction[6]. Fracture in the maxillofacial region can lead to airway problems due to pooled saliva, collection of blood clots and edema. Hence application of intermaxillary fixation can aggravate the compromised airway status. Several studies have been reported on the hazards of intermaxillary fixation[7]. Goss et al[8]pointed that patients may develop sudden airway obstruction following intermaxillary fixation and an emergency release may be life-saving. So, he advised wire cutter should be routinely available with the patients. Chigarin V N and Morozov P V[9] also emphasized the need of emergency release of intermaxillary fixation and they developed a device for the emergency removal of intermaxillary fixation. Shelia Fisher[10] in 1982 reported a case of acute airway obstruction immediately following the application of intermaxillary fixation, which finally led to cardiac and respiratory arrest. Hence following intermaxillary fixation, patients are at high risk for respiratory problems that may result in decreased arterial oxygen saturation. Pulmonary status evaluation becomes necessary on account of the obstructive nature of intermaxillary fixation. Evaluation of pulmonary status can be achieved by pulmonary function tests. William and Cawood[11] evaluated the effects of intermaxillary fixation on pulmonary function. They reported that there is airway restriction in patients with intermaxillary fixation and such patients are more vulnerable to sequalae of postoperative hemorrhage and edema.

The evaluation of human pulmonary function dates back to the 17th century. According to John Hutchinson's writings in 1846, Borelli is the earliest physiologist who established an experimental enquiry into the quantity of air received by a single inspiration machine. For next century, progress in developing techniques for pulmonary function testing was slow. In 1950s however, pulmonary physiologists took advantage of the opportunities offered by the burgeoning fields of electronics, transducers and computers. Currently there are many techniques for assessing pulmonary function.

Most lung function tests are interpreted by comparing the results with predicted or reference values. Spirometry is one of the simplest and most commonly preferred method. Spirometry is the measure of airflow and lung volumes during a forced expiratory maneuver from full inspiration. It includes three basic measurements. Forced vital capacity (FVC), Forced expiratory volume (FEV1), Ratio between FEV1 and FVC. In obstructive disorders, the airflow is reduced because the airways are narrow and FEV1 is reduced. The FVC may also be reduced because of gas trapped behind obstructed bronchi, but to a lesser extent than FEV1. Thus the cardinal feature of an obstructive effect is the reduction of the ratio of FEV1 to FVC.

Several comparative studies[12] with and without intermaxillary fixation were conducted and many favored the treatment without intermaxillary fixation for prolonged period because of low complication rate and reduced morbidity. However, the closed method of fracture reduction using intermaxillary fixation is still being practiced. The purpose of this study was to determine the effect of intermaxillary fixation on pulmonary function among the patients seeking trauma care in a tertiary referral center in central Kerala.

MATERIALS AND METHODS:

This prospective study was carried out on consecutive oral and maxillofacial surgery patients that required Intermaxillary fixation for the treatment of jaw fractures at Government Medical College & Hospital, Kottayam, Kerala. The Ethics Committee of the Hospital gave an approval to carry out the study. A verbal and signed consent were also obtained from each of the patients.

The patients who met the following criteria were studied: no history of previous cardiac or pulmonary ailments, non –smokers, patients

having full complement of teeth, age between 18 to 50 years. The patients selected were subjected to a detailed and systematic analysis that comprised of relevant history and clinical examination. The clinical diagnosis of fracture of maxilla or mandible was confirmed by radiographic aids. The cases indicated for closed reduction were selected for the study.

All the ages of the patients were approximated to the nearest birthday. The patients were weighed in kilograms in light clothes and without shoes using weighing machine. Their heights were measured in centimeters without shoes. Before applying intermaxillary fixation the patients were subjected to pulmonary function tests. Pulmonary function tests adopted in our study was spirometry, which is the measure of airflow and lung volumes during a forced maneuver from full inspiration. The forced expiratory volume in one second and the forced vital capacity and were recorded in liters using a vitalograph spirometer machine. All the gas volumes were measured at ambient temperature and pressure. All the tests were carried out with the patients seated after the purpose of the test was explained and the method of testing demonstrated to them. Each one was instructed to wrap his/her lips tightly round the disposable mouthpiece to prevent any leak around it. A nose-clip was applied to prevent air from escaping through the nostrils during the maneuvers and they were instructed to take a deep breath, and then exhale into the mouthpiece as deeply and as fast as possible while being encouraged. The above-mentioned criteria are in accordance to those laid down by the American Thoracic Society for acceptable and reproducible spirometry.

Pulmonary function tests in this study were performed by "Microquark" which is an electrical medical device. The core of the system is the intelligent flow meter when connected through the serial port turns any personal computer into a complete spirometric lab. The system is composed of the turbine flow meter, the measurement and data elaboration device, the communication cable and the software pack. The parameters included in the spirometry were[14]:

1. Vital capacity [VC]- defined as the volume of air expelled from maximal inspiration to maximal expiration during an unforced maneuver. Here the patient was asked to take a deep breath followed by a deep expiration without exerting too much force.
2. Forced vital capacity [FVC]- defined as the total volume of air expelled during a forced maximal expiratory maneuver. Here the patient was asked to perform deep inspiration and expiration in a forceful manner.
3. Forced expiratory volume 1[FEV1]-the volume of air expelled during the first second of a forced expiratory maneuver. The patient was asked to blow the air after a deep inspiration as in the earlier test and the reading was taken.
4. The ratio between the forced expiratory volume 1 and forced vital capacity. [FEV1/FVC]
5. Maximum voluntary ventilation [MVV]- the maximum ventilation that can be achieved in one minute. The patient was asked to breathe as hard and as fast as possible for 12 to 15 seconds and measuring the volume of air inspired or expired.

The various maneuvers were performed by the patient and the readings were visualized in the computer along with the graphical representation and the results were recorded. Each test was repeated after an interval of 5 to 10 minutes to allow the patient to regain his or her equilibrium[13]. The exercise was repeated 3 times and the maximum tracing was taken. After Pulmonary Function Tests were completed, the intermaxillary fixation was applied. The patient was reviewed every week and ensured of asymptomatic nature of the illness. After the stipulated period of 3 to 6 weeks, intermaxillary fixation was released and the patient evaluated[15]. Pulmonary function tests were repeated.

Fifty healthy volunteers were selected with age ranging from 18 to 50 and they constituted the control group. The pulmonary function tests were carried out in them and values recorded. The recordings obtained preoperatively and postoperatively were tabulated and compared with each other and the control group. These observations were subjected to statistical analysis using SPSS statistics version 25 to derive relevant conclusions from the study.

RESULTS

133 subjects were studied, of which 107 were males and 26 were females. Table 1 shows the age and gender distribution of subjects.

Table 1: Age And Gender Distribution Of The Subject

AGE	FEMALES	MALES	TOTAL
18-30	8	49	57
31-40	17	47	64
41-50	1	11	12
TOTAL	26	107	133

All the patients had Intermaxillary fixation as a result of jaw fractures following Road Traffic Accidents (RTA), assault or fall. The average of each parameter before and after intermaxillary fixation was calculated and compared using paired t test. Table 2 shows the mean values of pulmonary function test parameters before and after the application of intermaxillary fixation.

Table 2: Mean Value Of Each Parameter Before And After The Application Of Intermaxillary Fixation

PARAMETERS	Mean	N	SD
FVC Pre	97.312782	133	19.3141588
FVC Post	83.075188	133	15.1827075
FEV1 Pre	103.667669	133	25.6151694
FEV1 Post	82.292481	133	21.2837419
FEV1/FVC Pre	106.257143	133	12.5258901
FEV1/FVC Post	98.229323	133	15.0054373
MVV Pre	80.706015	133	13.1022191
MVV Post	63.968421	133	14.2200049

SD- Standard Deviation

The average value of each parameter was found to decrease after the application of intermaxillary fixation. Table 3 shows the statistical correlation of the parameters before and after the application of intermaxillary fixation.

Table 3: Statistical Correlation Of Each Parameter Before And After The Application Of Intermaxillary Fixation Using Paired Sample T Test

PARAMETERS	N	Correlation
FVC Pre & FVC Post	133	.810
FEV1 Pre & FEV1 Post	133	.855
FEV1/FVC Pre & FEV1/FVC Post	133	.779
MVV Pre & MVV Post	133	.734

The average value of FVC before and after the application of intermaxillary fixation was 97.31 and 83.075 respectively. The difference between the values were statistically significant with a t value of 14.48 and p value 0.000. FEV1 before and after the application of intermaxillary fixation was 103.66 and 82.29 respectively. The difference was statistically significant with a t value of 18.55 and p value of 0.000. The average value of FEV1/FVC before and after the application of intermaxillary fixation was 106.25 and 98.22 respectively. The difference between the values was statistically significant with a t value of 9.79 and p value 0.000. MVV before and after the application of intermaxillary fixation was 80.70 and 60.96 respectively. The difference was statistically significant with a t value of 19.25 and p value of 0.000 showing statistical significance. Fifty healthy volunteers were subjected to the test. The average value of each parameter was compared with the sample group before the application of intermaxillary fixation using independent sample t test. The results showed that there was no significant difference in values between the two groups. This again concluded that the reduction in pulmonary function test values were due to intermaxillary fixation.

DISCUSSION

Intermaxillary fixation for maxillomandibular fractures is still being used inspite of the advances in rigid internal fixation. This kind of connection has several merits and demerits, one of which is the impairment of respiratory process. In this study spirometric values of pulmonary function tests were analyzed before and after the application of intermaxillary fixation. These values when statistically analyzed, showed that the application of intermaxillary fixation reduced the spirometric values. The patterns of abnormalities in pulmonary function tests could be any of obstructive pattern, which stems from the narrowing of any portion of airway and decreases the airflow[16]. In the restrictive pattern it is associated with any diseases of lungs or any related structures and is characterized by reduction of lung capacities.

Forced expiratory volume [FEV1] in this study was found to decrease

from 106.25% to 98.22% after the usage of intermaxillary fixation. This reduction indicates the obstructive nature of intermaxillary fixation. Kim et al[7] and Masaki et al[17] in their study observed a decrease of 97.5% to 71.7% and 88.7% to 68.4% respectively. The ratio between the forced expiratory volume and forced vital capacity [FEV1/FVC] was observed to reduce from 106.25% to 98.22 %. The reduction of this ratio is critical as per the guidelines of American thoracic society. The reduction indicates the obstructive pattern of pulmonary function, and can be categorized in the mild obstructive pattern. The hallmark of obstruction of pulmonary function is limitation of airflow, this physiologic diagnosis rests primary on the demonstration of FEV1/FVC ratio below the lower limit of normal.

The forced vital capacity [FVC] was also found to decrease from 97.31% to 83.075% after the application of intermaxillary fixation. When forced vital capacity is reduced the residual volume is increased because of the trapped air in the lungs. This affects the compliance of the pulmonary tissues. Masaki et al[17] also proved from their study about the reduction of Forced Vital Capacity, from 95.9% to 87.3% after intermaxillary fixation.

Maximum voluntary ventilation [MVV] is the primary dynamic test for obstructive disease but now has been supplanted by the forced expiratory maneuvers for diagnosis of airflow limitation. Still it is used as a global assessment of ventilator capacity. In this study, the spirometric value of MVV tends to decrease from 80.70% to 60.96% after the application of intermaxillary fixation.

Attempts were made to compare the values of the pulmonary function tests of the control group and the patients undergoing intermaxillary fixation. Statistically no difference was noticed between the values, which indicates that the patients have a normal spirometric value before the institution of maxillomandibular fixation.

CONCLUSION

Intermaxillary fixation is a time-honored method of management of fracture by closed method. It has several advantages over the surgical intervention modalities and also certain demerits. The results obtained revealed that the spirometric values decreased significantly after the application of intermaxillary fixation. So this clearly explains the obstructive nature of intermaxillary fixation. If the values of spirometry are not corresponding to the normal values, it is dangerous to institute maxillomandibular fixation in those patients. The patients in whom respiratory condition is compromised like chronic obstructive pulmonary diseases, asthma the application of intermaxillary fixation should be carefully carried out. Intermaxillary fixation though a simple procedure, carries the risk of pulmonary function obstruction. Hence routine assessment of pulmonary function in respiratory compromised patients before the application of maxillomandibular fixation should be mandatory to avoid the unnecessary complications.

REFERENCES:

(1) Salicetti's cryrurgia translation into French Lyon- France 1492
(2) Gilmer T L. A case of fracture of lower jaw with remarks on treatment . Arch Dent. 4: 388,1887.
(3) Angle E. H- Angle system of treating fractures of maxillary bones. Br Journ.Dent.Science 17:303,1890
(4) Hardman FG, Boering G (1989) Comparisons in the treatment of facial trauma. Int J Oral Maxillofac Surg 18(6): 324–332
(5) Stacey DH, Doyle JF, Mount DL, Snyder MC, Gutowsky KA (2006) Management of mandible fractures. Plast Reconstr Surg 117(3): 48e–60et
(6) Hayten J P,Cawood J I. The functional care for miniplates in maxillofacial surgery. Int Journ Oral Maxillofac Surg 21:991-96,1993
(7) Kim C, Kim H, Kim M. Effect of intermaxillary fixation on pulmonary function. Int Journ of Oral and Maxillofac Surg Supplement vol 28,1999 Goss A N,Chay K K, Mayne L H. IMF-How predictable is emergency jaw release? Anaesth Intense Care 7:253, 1979.
(8) Chigarin V N, Morozov P V.A device for emergency removal of IMF for transportation in jaw fractures. Voen Med Zn Dec 12(50-51) 1988.
(9) Shelia E Fischer. Respiratory/ cardiac arrest complicating intermaxillary fixation. Br Journ Oral Surg.8;16-26,1980.
(10) William J G,Cawood J I. Effect of intermaxillary fixation on pulmonary fixation. Int Journ Oral Maxillofac Surg.19; 76-78, 1990.
(11) Sindet Pederson, Jensen T. Treatment of mandibular fractures with and without intermaxillary fixation – a comparative study. Oral Surg Oral Diagnosis.3:37-44,1992.
(12) Oduntan SA (1970) Spirometric studies of normal and preoperative patients in Nigeria. Afr J Med Sci 1(1): 79–84
(13) Reed M Gardener, Robert O Crapo, Steven B Nelson.Spirometry and flow volume curves. Clinics in chest medicine:vol 10,no 2, 1989.
(14) Juniper R P,Awty M D. The immobilization period for fractures of mandibular body. Oral Surg 36; 157 -163,1973
(15) Jack L Clausen. Prediction of normal values in pulmonary function testing. Clinics in chest medicine. Vol 10;no 2;1989.
(16) Masaki K,Tamio N, Genji S. Effects of maxillomandibular fixation on respiration. Journ Oral Maxillofac Surg. 51;992-996,1993.