

Use of bite force measurement as a clinical means for follow up of maxillofacial trauma management.

Original
Article

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ABSTRACT

Introduction: Maxillofacial trauma represent high percentage of body trauma, and its management is very important, Aim of the study: The aim of this work is to study the effect of maxillofacial trauma on bite force measurement

Subjects and methods: Two groups of patients was participated through this work

Control group , composed of 15 healthy subjects have participated to registers bite forces at molar and incisor regions,, and study groups composed of 15 persons affected by different maxillofacial trauma where bite force was registered at postoperative 1st week, 1st month,3rd month

Results: Bite force for maxillofacial trauma patient was significantly less than that of healthy patients at 1st week, 1st month postoperatively, while there is no significant difference through bite forces of both groups at the 3rd postoperative month

Conclusion: Maxillofacial trauma has a significant effect on bite force ,so that using bite force meter may be a valuable means to follow up maxillofacial trauma patients .

Key Words: Maxillofacial, trauma, bite force.

Received: 27 August 2021, **Accepted:** 14 September 2021.

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ISSN: 2090-097X, July 2021, Vol. 12, No. 4

INTRODUCTION

bite force depends on several factors as the integrity of the jaw bones, muscular force , number and integrity of teeth , temporomandibular joint functional harmony, maximum bite forces presented by different authors showed obvious inconsistency and this may be due to the calipration and accuracy of the devices used to record the bite force, , attitude and psychological state of the subjects , environmental ,genetic and ethnic factors.further to Individual neuromuscular mechanism^[1]

Incidence of maxillofacial trauma ranges from 17% to 69%, and this depends on several factors such as environmental factors, economic status,social culture , the traffic implications with the need of high speed for travelling ,, and also social violence^[2]

Maxillofacial trauma has a significant effect on the neuromuscular system and integrity of facial anatomy and this leads to change of the maximum bite force So that measurement of bite force can be considered as a significant factor for follow up and giving information about the healing progress of the masticatory system

AIM OF THE STUDY

The aim of this study is to investigate the effect of maxillofacial trauma on maximum bite force

MATERIAL AND METHOD

The patients presented with maxillofacial trauma were managed in maxillofacial surgery department faculty of oral and dental medicine south valley university from September 2020 till July 2021 Through this research 2 groups of patients were managed , the control group consisted of 15 healthy adult more than 18 years old , volunteers with intact dentation , where bite force was registered for them, The second test group consisted of 15 patients presented with different maxillofacial trauma , Informed consent was obtained from each patient participated through this study . information were recorded as regard the age , sex ,address , cause of trauma ,Open reduction and fixation, using miniplate was used to manage the fractures Bite force was registered through postoperative 1st week, 1st month, and 3rd month,

Bite force measurement

The bite forcemeter is consisting of a stainless steel bite force sensor of strain gauge type, capable of measuring up to 1000 N (code HE 6210, LOAD CELL 100 kg

manufactured by HARIUM ELECTRONICS, INDIA (Figure 1)



A



B

Figure 1 A and B: representing registration of bite force

All measurements were made while the patient seated upright, with Frankofort plane parallel to the ground in resting condition. The bite force instrument (transducer) could be conveniently positioned between the antagonizing cusps in the region of Left First Molar and Right First Molar and between incisors, bite force measurement repeated 3 times for each region

The results

Number of the control group patients was 15 with 9 males and 6 females their age mean 28.4 years with STD(standard deviation) ± 6.97751 , the mean bite force at right molar region was 331.2 Newton STD ± 59 .and at at left site molar region was 331.2 Newton and STD ± 54.6 while at the anterior region bite force was 150 Newton and STD ± 10.8 this shown in table 1, While the number of experimental group patients was 15 with 13 males and 2 females with the mean age, was 25.7 years and SD ± 6.386 , (table 2) For the maxillofacial trauma patients at 1st week the mean bite force at right molar region was 38.6Newton STD ± 31.6 .and at at left site molar region was 38.33333 Newton and STD ± 30.24582 while at the anterior region bite force was 29.93333 Newton and STD ± 22.8 this shown in (table 3) at 1st month the mean bite force at right molar region was 78.2 Newton and SD ± 35.4546 . and at at left site molar region was 79.46 Newton and STD ± 38.95 while at the anterior region bite force was 62.2 Newton and STD 28.58371 this shown in

(table 4) at 3RD month the mean bite force at right molar region was 289.2 Newton and SD ± 84.55531 .and at at left site molar region was 288.86667 Newton and STD ± 86.27602 while at the anterior region bite force was 151.26667 Newton and STD ± 26.30444 this shown in (table5)

on comparison between control and test group as regards ages of the subjects there was no significant difference and $p = 0.26162$ (table 6), as regards bite force comparison. on post operative 1st week the difference in mean maximum bite force between the control and experimental group at both right molar region, left molar region and anterior region was statistically significant and P values were $1.80513E-10$, $1.49017E-10$, $1.13536E-10$ respectively for all types of fracture, as shown on tables (7,8,9) also on post operative 1st month the difference in mean maximum bite force between the control and experimental group at both right molar region, left molar region and anterior region was statistically significant and P values were $8.9007E-10$, $6.61295E-10$, $1.59948E-8$ respectively for all types of fracture as shown on (tables 10,11,12) while at the 3rd month the bite force increased to the level that there was no significant difference between control and study group at both right, left and anterior regions while P values were 0.10212, 0.09041, 0.83134 respectively as shown in tables (13,,14,15)

Table 1 showing bite force values for control group along with the sex and ages of the volunteers (STD,standard deviation,SEM,standard error of mean)

serial	Right	left	anterior	sex	age
1	248	250	150	F	38
2	400	398	160	M	40
3	405	400	144	M	25
4	290	292	155	F	19
5	300	290	139	M	35
6	305	300	138	M	36
7	295	297	138	M	28
8	280	289	140	M	24
9	285	295	145	F	32
10	410	400	159	F	24
11	415	403	165	M	34
12	285	295	135	F	24
13	310	320	150	F	18
14	415	410	160	M	22
15	325	330	168	M	27
MEANS	331.2	331.2	150		28.4
STD	± 59.4	54.6	10.8	9M	6.97751
SEM	15.33785	33.5		6F	1.80159

Table 2 showing types and causes of trauma, along with the ages and sex of the patients

SERIAL	FRACTURE	Cause of truma	AGE	sex
1	Parasymphyseal fracture	Road traffic accedent	30	female
2	Body fracture	assults	25	male
3	PANFACIAL	Road traffic accedent	35	male
4	LEFT SUBCONDYLAR FRACTURE and symphyseal	Road traffic accedent	25	male
5	SYMPHYSEAL AND ZYGOMATIC	sports	25	male
6	Zygomatic complex fracture	Road traffic accedent	30	male
7	SYMPHYSEAI		22	male
8	Bilateral symph and left subcond	Fall down trauma	32	male
9	Symphyseal fracture	Road traffic accedent	22	male
10	BI LATERAL PARASYMPHSEAL =MAXILLARY Z= ZYGOMATIC	Road traffic accedent	19	male
11	Angle fracture	Animal accedent	19	male
12	SYMPHSEAL FRACTURE	Fall down trauma	20	male
13	LEFT ANGLE =zygomatic complex	Road traffic accedent	19	male
14	MAXILLARY AND LEFT ZYGOMATIC COMPLEX	Road traffic accedent	23	male
15	Zygomatic complex fracture	Road traffic accedent	40	female
Mean			25.73333	
SD			±6.386	

Table 3 showing bite force measurement for trauma patients at 1st week 1ST MONTH

SERIAL	RIGHT	LEFT	ANTERIOR
1	125	120	100
2	40	35	25
3	60	40	26
4	23	13	30
5	25	40	20
6	25	28	17
7	50	59	40
8	20	18	19
9	5	18	6
10	13	16	16
11	25	13	20
12	28	30	20
13	16	9	50
14	60	56	40
15	75	80	30
MEAN	38.6	38.33333	29.93333
STD	±31.6	±30.24582	22.8
SEM	8.16	7.8	5.8

Table 4 showing bite forc measurement for trauma patients at 1st month

1	139	125	130
2	60	45	30
3	100	80	45
4	55	45	65
5	40	60	35
6	60	65	55
7	90	100	80
8	70	65	55
9	65	70	60
10	30	40	40
11	100	128	99
12	70	77	60
13	34	19	36
14	120	110	100
15	140	163	43
MEAN	78.2	79.46	62.2
STD	35.4546	±38.95	28.58371
SEM	9.15434	10.05	7.38

Table 5 showing bite forc measurement for trauma patients at 3rd month

1	350	345	145
2	210	215	165
3	310	300	150
4	245	238	150
5	185	190	160
6	188	175	150
7	230	220	180
8	360	355	125
9	300	310	150
10	255	260	140
11	400	420	160
12	390	400	100
13	200	210	194
14	450	440	190
15	265	255	110
MEAN	289.2	288.86667	151.26667
STD	±84.55531	±86.27602	±26.30444
SEM	21.83209	22.27637	6.79178

Comparison of the groups
Table 6 showing ages of the groups

group	Age Mean in years	std	SEM	PROPABILITY
Control group	28.4	±6.97751	1.80159	0.26162 NON SIGNIFICANT
Test group	25.73333	±6.386	1.64886	

Table 7 showing difference of bite forces between control and test groups at 1st week for right molar site

group	Bite force mean in newton	std	SEM	PROPABILITY
Control group	331.2	±59.40322	15.33785	1.80513E-10 * SIGNIFICANT
Test group	39.33333	±30.91617	7.98252	

Table 8 showing difference of bite forces between control and test groups at 1st week for left molar site

group	Bite force mean in newton	std	SEM	PROPABILITY
Control group	331.26667	±54.63707	14.10723	1.49017E-10* SIGNIFICANT
Test group	38.33333	±30.24582	7.80944	

Table 9 showing difference of bite forces between control and test groups at 1st week for incisor

group	Bite force mean in newton	std	SEM	P VAUE
Control group	148.42857	±9.96698	2.66379	1.13536E-10* SIGNIFICANT
Test group	30.64286	±23.03378	6.15604	

Table 10 showing difference of bite forces between control and test groups at 1st month for right molar site

group	Bite force mean in newton	std	SEM	P VAUE
Control group	331.2	±59.40322	15.33785	8.9007E-10* SIGNIFICANT
Test group	78.2	±35.4546	9.15434	

Table 11 showing difference of bite forces between control and test groups at 1st month for left molar site

group	Bite force mean in newton	std	SEM	P VAUE
Control group	331.26667	±54.63707	14.10723	6.61295E-10* SIGNIFICANT
Test group	79.46667	±38.95394	10.05786	

Table 12 showing difference of bite forces between control and test groups at 1st month for incisor

group	Bite force mean in newton	std	SEM	P VAUE
Control group	148.42857	±9.96698	2.66379	1.59948E-8* SIGNIFICANT
Test group	62.2	±28.58371	7.38028	

Table 13 showing difference of bite forces between control and test groups at 3rd month for right molar site

group	Bite force mean in newton	std	SEM	P VAUE
Control group	331.2	±59.40322	15.33785	0.10212 NON SIGNIFICANT
Test group	289.2	±86.27602	21.83209	

Table 14 showing difference of bite forces between control and test groups at 3rd month for left molar site

group	Bite force mean in newton	std	SEM	P VAUE
Control group	331.26667	±54.63707	14.10723	0.09041 NON SIGNIFICANT
Test group	288.86667	±86.27602	22.27637	

Table 15 showing difference of bite forces between control and test groups at 3rd month for incisor

group	Bite force mean in newton	std	SEM	P VAUE
Control group	148.42857	±9.96698	2.66379	0.83134 NON SIGNIFICANT
Test group	151.26667	±26.30444	6.79178	

DISCUSSION

Maxillofacial fractures represent 16% to 69 %of the body trauma, management of this type of fractures aims to restore the function and facial conformity, as regard the function it means good occlusion and biting force to enable the patient for eating^[3] So that recording of bite force can be a considerable tool for follow up of the maxillofacial facial fracture management .there are multiple means for recording bite force including strain-gauge transducers,. Piezoelectric transducers, and . Pressure transducers^[4] Through this study the used bite forcimeter was depending on strain gauge transducers .because it was used through out several studies with good results while it depends on the idea that any deformation through the strain gauge leads to change in electric current that is translated into loads ^[5] throughout this study the bite force at the molar region was ranged from 248 to 415 newton ,and fore incisor region was ranged from 135 to 165 newton this is similar to the study of Stanley et al ⁶ and with the study of Fedock et al ^[7] through the literature there are variable measurements of bite forces and this may be due to different devices for bite recording also different environmental conditions along with different ages and sex, through this study the results of the experimental group was compared with that of control group while there was no significant difference according to their ages and selected from the same region , throughout this study males are more exposed to maxillofacial trauma than females and this may be due to the nature of men works and their increased hours out of home and their behavior this finding meets that is recorded through the literature ^[8]

through this study the effect of sex on bite force cannot be determined because number of females to males is small ,however different studies stated that females may have less bite forces than males. And this indicates that the bite force is affected by sex^[6,9].

in this study road traffic accidents was the most the most prevalent cause of the maxillofacial trauma, this because of increased level of civilization and increased need for high speed travelling, also many of peoples neglect the safety procedures of traffic , road traffic accident is considered the main cause of maxillofacial trauma ^[10,11] through this 15 patients in group 2 were managed surgically and the bite force was evaluated at the 1st week, 1st month, and 3rd month,. At the end of 1st week and 1st month the bite force was significantly less than the range of normal bite force, however at the end of 3rd post operative Month the bite force was restored towards the normal range this finding also similar to the study of Ellis and Walker in 1996 ^[12], that found that bite forces in the acute postoperative period are much lower than bite forces recorded later in the postoperative period also Haug^[13]

has determined bite force to be 100 newton at anterior teeth and 200 newton at molar teeth for biomechanical evaluation of different fixation system depending on the fact that bite force reduced dramatically in postoperative period the significant decrease of bite force at the 1st week and month postoperatively may be due to injury of masticatory muscle by trauma itself or during surgical procedures and retraction , most of the traumatized patient are afraid to bite, also decreased bite force may be due to neuromuscular protective mechanism due to feeling of pain improved bite force at the 3rd month is due to progressing healing, with decreased pain sensation and resolution of oedema and inflammatory reaction after surgery all these findings are in accordance to the study of Abhinandan et al³ thus evaluation of bite force can be taken as a means for clinical evaluation of maxillofacial trauma, where decreased bite force during healing period of maxillofacial fractures may give an impression of delayed healing, presence of infection , or inadequate reduction of the fractures, also through measurement of bite force , we can advise the patient about the type of foods he can eat either semisolid, solid according recorded bite force .

CONCLUSION

bite force measurement after maxillofacial fractures management may be a valuable means for follow up of such fractures

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- 1- Koc D, Dogan A, Bek B. Bite force and influential factors on bite force measurements: a literature review. *European journal of dentistry*. 2010 Apr;4(2):223)
- 2- Gupta A, Singh V, Mohammad S. Bite Force Evaluation of Mandibular Fractures Treated With Microplates and Miniplates. *J Oral Maxillofac Surg*. 2012;70(8):1903–8
- 3- Abhinandan Patel A., Girish G1, Kora Ramya ReddyK, Rajendra K S1,Sneha T R and Akarsh R. Bite force measurement in maxillofacial trauma – A clinical prospective study .*Journal of Oral Medicine, Oral Surgery, Oral Pathology and Oral Radiology* 2021;7(1):42–49

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- 4- Verma T.P., KUMATHALLI K .R, Jain V, Kumar R. Bite Force Recording Devices - A Review,, Journal of Clinical and Diagnostic Research. 2017 Sep, Vol-11(9): ZE01-ZE05
- 5- Kinra PK, Jayakumar K, Soumithran CS, Michael MJ, Passi D, Singh M. Comparative evaluation of bite force analytical study following mandibular osteosynthesis using threedimensional and conventional locking miniplates. Natl J Maxillofac Surg 2017;8:34-40.
- 6- Braun S ,Bantleon HP, Hnt WP, Freudenthaler JW, Mrcotte MR And Johnson BE ,A Study Of Bite Force, Part 1: Relationship To Various Physical Characterstics, Stanley et al, The Angle Orthodontist, Vol. 65 No. 5 1995)
- 7- Fedok FG, Van Kooten DW, DeJoseph LM, McGinn JD, Sobota B, Levin RJ, et al. Plating techniques and plate orientation in repair of mandibular angle fractures: an in vitro study. Laryngoscope. 1998; 108: 1218-24.)
- 8- Pal P.K. Sushmitha R, G.V. Motivale M and Tiwari T. Evaluation of post-operative bite force in mandible fractures treated with open and closed reduction, int. j. adv. res. 5(2), 1002-1008)
- 9- Estimation of Individual Bite Force during Normal Occlusion using FEA, Dattatreya Parle in 2013 ALTAIR TECHNOLOGY SYSTEM, INFOSYS.
- 10- Down KE, Boot DA, Gorman DF. Maxillofacial and associated injuries in severely traumatized patients: implications of a regional survey. Int J Oral Maxillofac Surg. 1995;24(6):409-12.)
- 11- M. Lydia., AND Sharara A Retrospective study of maxillofacial trauma in Alexandria University: Analysis of 177 cases all the maxillofacial fractures through this study were managed using open reduction and fixation , Tanta Dental Journal 13:28-33
- 12-28- Ellis E 3rd, Walker LR. Treatment of mandibular angle fractures using one noncompression miniplate. J Oral Maxillofac Surg. 1996; 54: 864-71
- 13- Haug R, Fattahi T, Goltz MA. Biomechanical evaluation of mandibular angle fracture plating techniques. J Oral Maxillofac Surg. 2001; 59: 1199-210.