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Evaluation of Changes in Bite Force and Occlusal Contact Area Before and After Bilateral Sagittal Split Osteotomy of Mandible

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Abstract

Bite force is the primary indicator of the functional status of the masticatory system which results from the action of masticatory muscles and modified by the craniomandibular biomechanics. Evaluation of bite force and occlusal contact area has been considered important in the diagnosis of the disturbances of the stomatognathic system[1,2] The study was conducted to assess the long-term changes of bite force and occlusal contact area in patients with prognathic mandible before and after bilateral sagittal split osteotomy as a means of assessing masticatory function. As per the results of the study, both the bite force and occlusal contact area in the patients at six months, first, second and third year after surgery were significantly greater than the preoperative levels. Bite force and occlusal contact area values began to increase after 3 months of corrective orthognathic surgery in prognathic patients, which was later improved to maximum within first three years after surgery. The measurement is affected by the masticatory muscular activity and dental and occlusal conditions. Therefore all these measurements reflects the functional masticatory biomechanics in BSSO patients and the effectiveness of the corrective orthognathic surgery in mandibular prognathic patient to achieve a satisfactory functional rehabilitation.

Keywords: Bite force, T-scan, bilateral Sagittal split osteotomy.

Introduction

Bite force is the primary indicator of the functional status of the masticatory system which results from the action of masticatory muscles and modified by the craniomandibular biomechanics. Evaluation of bite force has been considered important in the diagnosis of the disturbances of the stomatognathic system[1,2]. Patients seeking the treatment for mandibular prognathism require functional rehabilitation along with improvement in aesthetics for stable and harmonious functioning of the stomatognathic system. These patients tend to have poorer masticatory function than normal individuals.A major contributing factor is poor occlusion, with anterior and posterior crossbite and poor intercuspation. Another reason could be the weaker capacity of the masticatory musculature, which has been shown to be smaller in dimension and decreased electromyographic activity due to the reduced functional stimulation[3]. All these factors may also contribute to an array of temperomandibular disorders.

The postsurgical recovery of masticatory function is of paramount importantance in such patients. Of the varied methods, maximum bite force is widely recognized as an effective indicator of both the state of the dentition and capacity of the masticatory muscles. Improved outcomes signify the success of a procedure. Hence the main objective of orthognathic surgery in patients with a dentofacial deformity is improvement in masticatory function as well as aesthetics.

Voluminous data are available in the literature regarding evaluation of preoperative and postoperative masticatory function following corrective orthognathic surgery. A large number of studies have used measurement of bite force as the means of assessment of the efficacy of masticatory function. But unfortunately they are either having a very short term postoperative follow-up or the numbers of cases followed up are too small for a credible conclusion. In this study we have followed up substantially larger group of patients over a longer period of time.

Objectives

The study will be conducted to assess the long-term changes of bite force and occlusal contact area in patients with prognathic mandible before and after bilateral Sagittal split osteotomy as a means of assessing masticatory function.

Materials and Methods

The study was conducted in all the patients who underwent corrective orthognathic surgery for mandibular prognathism during the period of January 2013 – January 2019 in the Department of Oral And Maxillofacial Surgery, Government Dental College and Hospital, Kottayam and completed a minimum of 3 year follow-up. All patients underwent orthodontic treatment before and after operation.

Inclusion Criteria

- Patients with complaint of mandibular prognathism and treated by BSSO.
- Patients with completely erupted healthy first and second molars.
- Patients without history or symptoms of TMJ disorders / trauma preoperatively.
- Patients with minimum of three years of follow-up.
- Surgery done by same surgeon.

Exclusion Criteria

- Patients with history of TMJ disorders / trauma preoperatively.
- Patients with missing either first or second molar.
- Patients not completing minimum five years follow-up.

Mandibular setback surgery (BSSO) was performed by the methods of Trauner and Obwegeser[4]. The appliance for repositioning the proximal segment was also applied during surgery. The bony segments were fixed bicortically in the angle region with titanium screws. Maxillomandibular rubber elastics (3⁄16 or 1⁄4 inch, medium- light) were applied after the surgery. The rubber elastics were removed within 2 months after the surgery for the guidance and post- operative orthodontic treatment was continued.

The bite force was measured by using the T scan consisting of a pressure sensitive sheet and an analyzing software[5]. When the sheet is bitten, microcapsules with color-forming material are broken to react depending on the occlusal contact. It is then scanned by the occlusion pressure graph. Bite force and occlusal contact area are calculated from the intensity and depth of coloring and displayed graphically and numerically in the monitor which is already connected to the T scan (Fig I and II). During measurement, the subjects were seated with their head in an unsupported natural position, looking forward. The pressure-sensitive sheet is placed between the upper and lower dental arch and the subjects instructed to bite as forcefully as possible for about 3 seconds. The recordings were then analyzed using the software in the T scan system. This evaluation was repeated 3 times per subject, and the 3 values were averaged.

All three readings were measured in all the patients of this study just before the surgery and at 2 weeks, 1 month, 3 months, 6 months, 1 year, 2 years and 3 years after the surgery.

Statistics

In this study since the data follows a normal distribution, preoperative and postoperative values of bite force and occlusal contact area were compared using paired t test. Statistical significance was defined as a probability value of less than .05.

Results

The statistical analysis of preoperative and postoperative comparison of bite force and occlusal contact area in the patients are shown in Tables I and II. The bite force and occlusal contact area in the patients at 2 weeks and one month after surgery were significantly lower than its preoperative values. Both the bite force and occlusal contact area decreased to its lowest value at 2 weeks after surgery. The bite force and occlusal contact area values reached its preoperative level or above, by third month after surgery. After three months of surgery these values were consistently increased to above the preoperative level and attained its maximum by the third year of follow-up. According to the statistical analysis, both the bite force and occlusal contact area in the patients at six months, first, second and third year after surgery were significantly greater than the preoperative levels.

Discussion

The bite force and occlusal contact area in the patients at 2 weeks and one month after surgery were significantly lower than its preoperative values. Both the bite force and occlusal contact area was decreased to its lowest value at 2 weeks after surgery.

The bite force and occlusal contact area values regained to its preoperative level or above by 3 months after surgery. After three months of surgery these values consistently increased and reached above the preoperative level and attained its maximum value by the third year of follow-up.

Many investigators have meticulously performed several studies on the bite force and occlusal contact area in patients with mandibular prognathism before and after surgical correction. They have found that patients scheduled for orthognathic surgery have a lower bite force and occlusal contact area than controls. Previous studies

have shown that a significant reduction in bite force occurs during orthodontic treatment in patients scheduled for corrective Orthognathic surgery. They concluded that the reduction resulted from the pain and discomfort caused by the orthodontic appliances. Pre-surgical orthodontic treatment, unlike routine treatment, usually increases the severity of the malocclusion because the goal of treatment is to obtain stable postoperative occlusion. Consequently, this treatment itself may produce a reduction in bite force and occlusal contact area. Iwase et al showed that the bite force and occlusal contact area in patients with mandibular prognathism before orthognathic surgery and orthodontic treatment were less than those of control subjects with normal occlusion.Iwase et al also reported that the bite force and occlusal contact area in patients steadily increased by 1.7 and 2.2 times in males and 1.9 and 2.4 times in females at 2 years after surgical correction, respectively when compared with the values at initial medical consultation6. Nagai et al reported that bite force and occlusal contact area at 12 months after BSSO had increased by 1.4 and 1.4 times in males and 2.0 and 1.8 times in females respectively7, compared with Iwase et al, Ohkura et al similarly reported that bite force and occlusal contact area at 3 years after SSRO were increased by 2.3 and 2.5 times in males and 2.4 and 2.7 times in females, respectively when compared with preoperative values8.In contrast, Throck Morton et al , Ellis et al and Shiratsuchi et al reported that the bite force of patients steadily. Increased after surgery and approached normal values 1–3 years after orthographic surgery8,9,10. Ohkura et al have suggested that these differences may be due to the method of occlusal bite force measurement employed8. Bite force and occlusal contact area seem to be closely related with the activity of the masticatory muscles. Raustia and Oikarinen reported that the mean electric activities of the masseter and anterior temporal muscles during maximal bite returned to the preoperative values by 3 months after mandibular sagittal split osteotomy and then clearly exceeded the preoperative values at 1 year after the surgery, reaching a plateau[11]. Ingervall et al reported that the electric activities of the masseter and temporal muscles during maximal bite increased to values approaching those in normal individuals at 8 months after surgical correction of mandibular prognathism[12]. Their data suggest that the activities in the masseter and temporal muscles of the patients during maximal bite reach a normal level by approximately 1 year after corrective orthognathic surgery. But in our study the bite force and occlusal contact area values reached its preoperative level or above by 3 months after surgery. After three months of surgery these values consistently increased to above the preoperative level and attained its maximum by the third year of follow-up.

Islam etal stated that the masticatory efficiency at 3 months after surgery was greater than that found pre-surgically and the increase was significant at 6 months after surgery[13]. Occlusal forces, although improved, will be lower in corrected prognathic patients than in normognathic patients even at 2 years after surgery. The postoperative increases of the bite force and occlusal contact area are likely to be produced by the increased activity of the masticatory muscles. However, because the bite force and occlusal contact area that are measured with the pressure sensitive sheet are recorded through the use of functional contact of the teeth at the intercuspal position, they are affected not only by the muscle activity but also by dental and occlusal conditions[14,15]. Therefore, their postoperative increases may not always be in proportion to the postoperative activity in the masticatory muscles.

Conclusion

In our study bite force and occlusal contact area values increased after 3 months of corrective orthognathic surgery in prognathic patients. Both values were get improved to maximum within first three years after surgery. The measurement is affected by the masticatory muscular activity and dental and occlusal conditions. Therefore all these measurements may indicate the functional state of the masticatory system of the patients after BSSO surgery, which in turn reflects the functional masticatory biomechanics in BSSO patients and the effectiveness of the corrective orthognathic surgery in mandibular prognathic patient to achieve a satisfactory functional rehabilitation.

References

1. Bakke M. Bite force and occlusion. Semin Orthod. 2006; 12:120-126.
2. Calderon Pdos S, Kogawa EM, Lauris JR, Conti PC. The influence of gender and bruxism on the human maximum bite force. J Appl Oral Sci. 2006;14:448-453
3. Duygu Koch, Arife Dogan, Bulent Belk. Bite Force and Influential Factors on Bite Force Measurements: A Literature Review. European Journal of Dentistry. 2010; 4: 222-223.
4. Trauner R, Obwegeser HL. The surgical correction of mandibular prognathism and retrognathia with consideration of genioplasty: Part I, surgical procedures to correct mandibular prognathism and reshaping of the chin. Oral Surg Oral Med Oral Pathol. 1957;10:677-89
5. Maness WL, Benjamin M, Podoloff R, Boblick A, Golden RF. Computerized occlusal analysis: a new technology. Quintessence Int. 1987;18:287-92.
6. M. Iwase, M. Ohashi, H. Tachibana, T. Toyoshima, M. Nagumo. Bite force, occlusal contact area and masticatory efficiency before and after orthognathic surgical correction of mandibular prognathism. Int. J. Oral Maxillofac. Surg. 2006; 35: 1102–1107.
7. Nagai I, Tanaka N, Noguchi M, Suda Y, Sonoda T, Kohama G. Changes in occlusal state of patients with mandibular prognathism after orthognathic surgery: a pilot study. Br J Oral Maxillofac Surg. 2001: 39: 429–433.
8. Kazunori Okura, Kiyoshi Harada, Seiko Morishima, and Shoji Enomoto. Changes in bite force and occlusal contact area after orthognathic surgery for correction of mandibular prognathism. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2001; 91: 141-5.
9. Ellis III E, Throckmorton GS, Sinn DP.Bite forces before and after surgical correction of mandibular prognathism. J Oral Maxillofac Surg. 1996: 54: 176–181.
10. Throckmorton GS, Buschang PH, Ellis E. Improvement of maximum occlusal forces after orthognathic surgery. J Oral Maxillofac Surg. 1996;54:1080-6
11. Raustia AM, Oikarinen KS. Changes in electric activity of masseter and temporal muscles after mandibular sagittal split osteotomy. Int J Oral Maxillofac Surg. 1994: 23: 180–184.
12. Ingervall B, Ridell A, Thilander B. Changes in activity of the temporal, masseter and lip muscles after surgical correction of mandibular prognathism. Int J Oral Surg. 1979: 8: 290–300.
13. I. Islam, A.A.T. Lim, R.C.W. Wong: 2017. Changes in bite force after orthognathic surgical correction of mandibular prognathism: a systematic review. Int. J. Oral Maxillofac. Surg. 2017;46(6): 746-755.
14. Ferrario VF, Sforza C, Zanotti G, Tartagilia GM. Maximal bite force in healthy young adults as

predicted by surface electromyography. J Dent. 2004;32:451- 457.

15. Braun S, Freudenthaler JW, Hönigle K. A study of maximum bite force during growth and development. Angle Orthod. 1996;66:261-264.

Legends Tables and Figures

Table 1: Statistical significance between preoperative and postoperative bite force (Newton) among the subjects.

Paired Samples Test

	Paired Differences					t	df	Sig.(2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
2wk - Preop	- .5715E2	15.1077	2.6707	-162.5938	-51.7000	-58.841	31	.001
1month - Preop	-72.6031	20.7205	3.6629	-80.0737	-65.1326	-19.821	31	.001
3month - Preop	7.7031	13.6230	2.4082	2.7915	12.6147	3.199	31	.003
6month - Preop	64.8906	26.2100	4.6333	55.4409	74.3404	14.005	31	.001
1yr - Preop	1.6623E2	47.4870	8.3946	149.1104	183.3521	19.802	31	.001
2yr - Preop	2.8399E2	67.3942	11.9137	259.6955	308.2920	23.838	31	.001
3yr - Preop	3.6613E2	89.9932	15.9087	333.6884	398.5804	23.015	31	.001

All the paired comparisons are statistically significant, so we can reject the null hypothesis and accept thealternative. There is a statistically significant difference in mean change of bite force among all the paired observations.

Table 2: Statistical significance between preoperative and postoperative occlusal contact area (square millimeters) among the subjects.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	2wk - Preop	-.9750	.7089	.1253	-4.2306	-3.7194	-31.718	31	.000
Pair 2	1month- Preop	-.6531	.9909	.1752	-3.0104	-2.2959	-15.146	31	.000
Pair 3	3month- Preop	.1438	.3426	.0606	.0202	.2673	2.373	31	.024
Pair 4	6month- Preop	.8563	.3331	.0589	.7362	.9763	14.543	31	.000
Pair 5	1yr - Preop	1.7031	.5515	.0975	1.5043	1.9020	17.468	31	.000
Pair 6	2yr - Preop	3.2875	.4969	.0878	3.1083	3.4667	37.424	31	.000
Pair 7	3yr - Preop	5.1125	.7598	.1343	4.8386	5.3864	38.065	31	.000

All the paired comparisons are statistically significant, so we can reject the null hypothesis and accept the alternative. There is a statistically significant difference in mean change of contact area among all the paired observations.

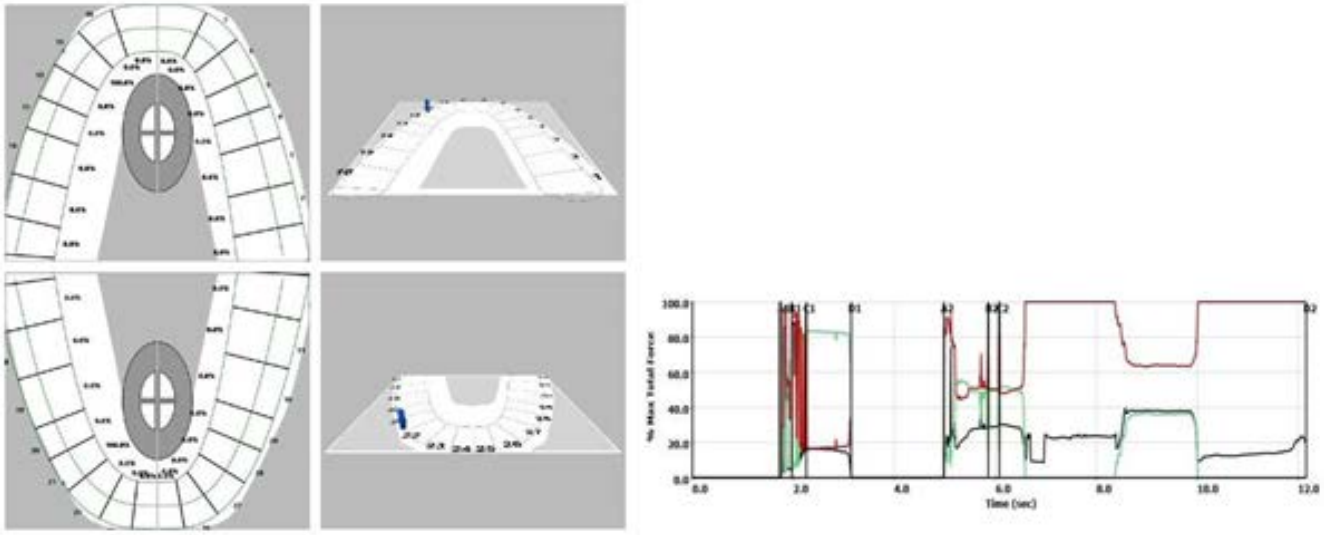

Fig. 1: Measurement of bite force and occlusal contact area using T scan in a patient at 2 weeks after BSSO.

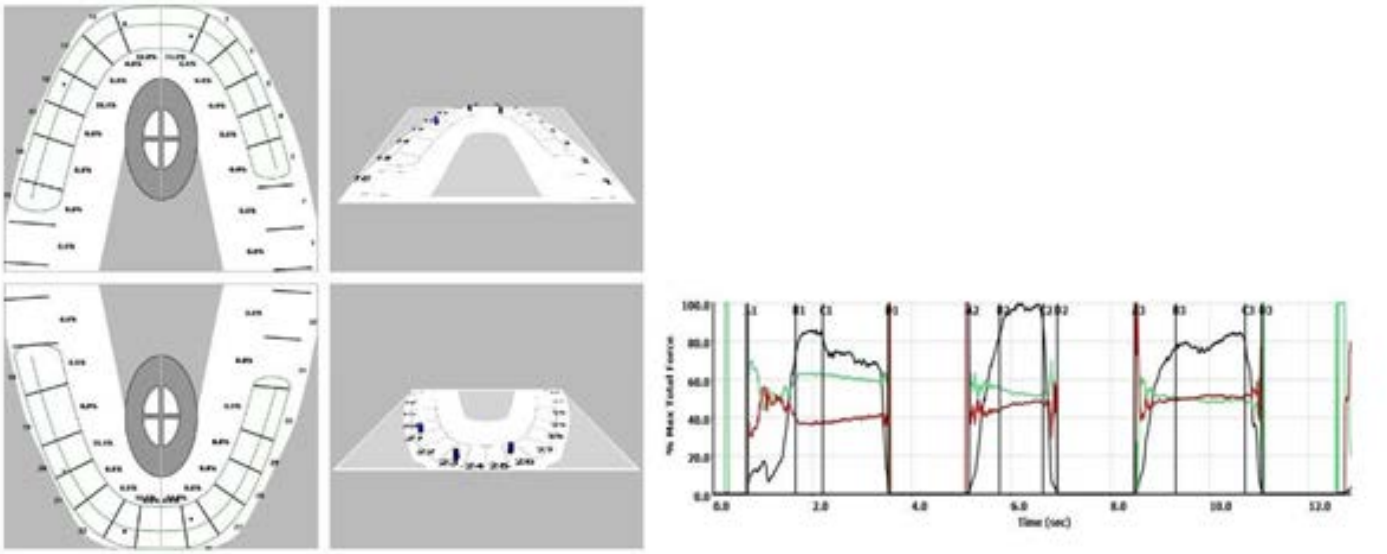

Fig.2: Measurement of bite force and occlusal contact area using T scan in a patient at 3 months after BSSO.