A Comparative Evaluation of Maximum Bite Force between Temporo-Mandibular Joint Ankylosis Patients and Healthy Individuals

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ABSTRACT: Various studies have shown that the bite force has been a good predictor of the performance of mastication as well as the functional state of the masticatory system which involves the TMJ and the muscle of mastication. But limited knowledge is available on Bite force in TMJ ankylosis patients after release of ankylosis. In our observational study, masticatory function was evaluated by measuring maximum voluntary bite force (MVBF) in 20 unilateral TMJ ankylosis patients who were treated with Temporalis fascia interpositional arthroplasty and compared with the normal population who were age and gender matched with the study group. Bite force was recorded on the bilateral molar and incisor region using an indigenous strain guage type bite force recorded. We found that mean bite force in our study group at the end of 3 months post-surgery in molar and incisor region were 62% and 50% less respectively when compared to control group individuals. Thus, bite forces in TMJ ankyloses patients might significantly improve and will probably become comparable to normal healthy individuals after the completion of a comprehensive treatment comprising of interpositional arthroplasty, jaw reconstruction, aggressive physiotherapy, orthognathic surgery, orthodontic and periodontal treatments.

Keywords: *Bite force, Maximum voluntary bite force (MVBF), TMJ ankylosis release, Masticatory function.*

INTRODUCTION

Temporomandibular joint (TMJ) ankylosis leads to functional, aesthetic and phonetics disability[1].The aim of surgical treatment is to release the bony fusion and restore the form and function of the facial skeleton[2]. Aggressive physiotherapy acts as an important adjunct to surgery as it prevents re-ankylosis and builds up muscle bulk as well thus leading to restoration of jaw function which can be quantitatively assessed using bite force as an indicator[3].

Bite force is the net result of different components (muscles, bones and teeth) acting in a coordinated manner[4]. Studies have analysed restoration of jaw function after surgical intervention in TMJ disorders using bite force but literature is scarce when it comes to studies involving bite force assessment in TMJ ankylosis patients.

Thus, the purpose of the study was to quantitatively assess the post-surgical functional improvement in patients presenting with TMJ ankyloses.

MATERIALS AND METHODS

This observational study was conducted on the patients reporting to the Outpatient Department of Oral and Maxillofacial Surgery of our institution. This study was approved by the Institutional Ethical Committee (IEC No. - D.No. 50/FM/IEC.)

The case group/ Group 1 consisted of a total of 20 patients who were diagnosed with Unilateral TMJ ankylosis and treated with interpositional arthroplasty with Temporalis fascia was included in the study. Those patients with recurrent ankylosis or bilateral ankylosis or non-compliant to exercise during the follow up period were excluded from the study.

The control group/ Group 2 consisted of 20 healthy subjects who were age and gender matched with the case group without any complaint pertaining to the Temporo-mandibular joint or dental disease.

Other inclusion criteria for both groups were the presence of completely erupted permanent central incisors, first permanent molars in occlusion, and the absence of dental related pain.

All the patients of Group 1 underwent interpositional arthroplasty utilising temporalis fascia as the interpositional graft. Surgical approach used was as described by Al Kayat Bramley[5]. Post-surgical care along with antibiotic and analgesics were given. Post- operative physiotherapy was started after 7-10 days. Preoperative and postoperative mouth opening were measured up to 3 months of follow up. Bite force was measured by an electronic bite force recording device designed by the Division of Ergonomics, Department of Mechanical Engineering, of our institution. The same apparatus has been used in previous studies involving bite force measurement in our department[6]. Bite force was recorded 3 months post-surgery in the molar and incisor region in Group 1 patients. Similarly Bite force was recorded in the control group (Group II) in the molar and incisor region and were compared with Group I. (Fig 1) The inter-incisal distance in Group I was measured preoperatively and 3 months post-operatively and tabulated as Mouth opening.

FIG 1: Recording Bite force on a) and b) molar region and c) incisor region.

The Bite force and mouth opening data were statistically analysed using statistical software SPSS 20.0 version. The normality of data was tested by Shapiro Wilks test and Kolmogorov Smirnov test. An informed consent was obtained from both the case and control group.

RESULTS

The study group consisted of 11 male and 9 female patients with mean age of 12.45 years. The mean mouth opening was 39.2±0.8mm (Table 1). Recurrence was not observed in any of the case till the last follow up visit. One case developed infection at incision site which was managed with antibiotics and wound care and one case developed hypertrophic scarring of skin at the incision site. Table 2 shows the distribution of mean bite force on the incisor and molar region.

Table 1: Pre-operative and 3months post-operative mouth opening of Group-1

	Mean	Std. Deviation	Std. Error Mean	t	p value
Pre-operative mouth opening	2.760	2.3350	.5221	39.471	.000
3 months post op mouth opening	39.200	3.7775	.8447		

Table 2: Bite force in incisor and molar regions among the groups

Bite force	Group	N	Mean	Std. Deviation	Std. Error Mean	t	p value	95% Confidence Interval of the Difference	
								Lower	Upper
Incisor region	1	20	10.4100	3.12543	.69887	5.218	<0.001	6.38381	14.47619
	2	20	20.8400	8.37430	1.87255				
Molar region	1	20	19.3200	5.76182	1.28838	4.451	<0.001	6.43285	17.16715
	2	20	31.1200	10.36256	2.31714				

DISCUSSION

Bite force has been considered an important tool to diagnosis the disturbances of the stomatognathic system. A strong correlations exists between bite force and mastication efficiency (van der Bilt, 2011)[7]. Determination of individual bite force level has been widely used in dentistry, mainly to understand the mechanics of mastication, for evaluation of the therapeutic effects of prosthetic devices and to provide reference values for studies on the biomechanics of prosthetic devices[8].

However, bite force as a quantitative determinant of functional restoration in patients of TMJ ankyloses has been evaluated in a few studies only.

In a study, Ejaz et al. found that bite force after 1 year follow upin children less than 12 years, did not vary significantly than the normal subject but it was significantly less in subjects over 12 years of age. He attributed this to growth potential in children which helps in restoring the normal function of muscles at a faster rate[9]. Kumar et al[10] observed 66.7% gain in bite force over a period of 1 year in unilateral ankylosis patients than normal subjects. Another study by Linsen et al.[11] on MVBF after total joint replacement in 17 patients, concluded after one year that the bite force significantly increased, depending on the occlusion.

We found that mean bite force in our study group at the end of 3 months post-surgery in molar and incisor region were 62% and 50% less respectively when compared to control group individuals. We attribute our findings to four reasons:

First is disuse atrophy. We concur with Hellinger and Hariman that disuse of masticatory muscles can affect the physiologic processes, such as activity of the muscle and may even lead to atrophy[12]. In patients of TMJ

ankylosis, the movements of the jaws is restricted depending on the degree of ankyloses and in severe cases, the joint becomes totally immobile. The limited mobility/immobility reduces the activity of the muscles and lead to their atrophy.

Secondly, it is the shortening of the muscles as an adaptation which contributes to decreased bite forces. El Labban and Canniff, in their study in cases of mandibular hypomobility associated with restricted mouth opening found temporalis and masseter muscles to adapt by shortening[13].

Thirdly, stripping the masseter and temporalis muscle as well as the lateral pterygoid muscle (upper head) during exposure and removal of ankylotic mass may lead to loss of jaw-closing forces[11]. Huang observed in his study in pigs that the response to loss of a muscle is a strong immediate compensation by synergists. Nevertheless, he concluded that even removal of a single muscle was found to cause a substantial loss of muscle force[14].

Finally, patients of TMJ ankyloses often have periodontally weak dentition due to restricted access to oral hygiene caused by limited mouth opening. This reduces the bite forces as dentition is utilized to assess the intensity of bite forces generated by muscles.

Postoperative physiotherapy in TMJ ankyloses patient plays its role in preventing re-ankylosis and increasing functional efficiency by disrupting the post-surgical haematoma and stimulating the masticatory muscles respectively[3]. This increased stimulation coupled with restoration of chewing leads to muscle growth and hence increase in bite force. Moreover, there is improvement in periodontal conditions after release of ankyloses as the dentition becomes more amenable to instituting hygienic procedures like tooth brushing. This further improves the condition of the dentition and thus, the bite forces.

A shortcoming of this study is the short follow up period of 3 months only. A longer follow up period might demonstrate more significant increase in bite forces as Ejaz[9] also has pointed out that reduced bite forces in such patients maybe because of a delay in the re-adaptation of the function of these muscles.

CONCLUSION

The intensity of bite forces are determined mainly by muscle capacity whereas masticatory forces depend on the number of motor units, muscle cross-sectional areas, the type of muscle cells, the angle at which the muscle acts to the bone, and on training. We are of the opinion that bite forces in TMJ ankyloses patients will significantly improve and will probably become comparable to normal healthy individuals after the completion of a comprehensive treatment comprising of interpositional arthroplasty, jaw reconstruction, aggressive physiotherapy, orthognathic surgery, orthodontic and periodontal treatments.

CONFLICT OF INTEREST

There is no conflict of interest.

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