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RESEARCH ARTICLE

EVALUATION OF BITE FORCE IN COMPLETELY AND PARTIALLY EDENTULOUS PATIENTS (PRE AND POST REHABILITATION).

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Abstract

The aim of this study was to determine the maximum bite force prior and post rehabilitation in completely and partially edentulous patients rehabilitated with either complete denture, removable partial denture, fixed partial denture or implants in comparison with the control group in 75 patients belonging to each group who were randomly selected after clinical examination. A total of 75 patients made up the study population. The study was carried out with the aim of measuring the maximum bite force using the bite force meter. Comparison was made amongst the bite forces of control group with that of the study groups. Implants followed by fixed partial denture group exhibited an excellent increase in pre to post rehabilitation stages with its values evenly distributed between the genders across all the study groups. Further, a greater bite force was exhibited in fully dentate patients (controls) in the overall study. Higher bite forces were elicited in patients rehabilitated with implants and is considered as the most effective mode of rehabilitation with maximum bite force in comparison with the other rehabilitation methods.

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Introduction:-

Mastication is a highly coordinated neuromuscular function involving purposeful movements of the jaw and continuous modulation of force, representing a function that matures with growth as the teeth erupts. It is characterized by complex movements of the stomatognathic system structures, most importantly the mandible, which varies depending on the foods ingested, resulting in manipulation of a food bolus, salivation, and associated oscillatory movements of the head. The loss of teeth, and consequently, prosthodontic rehabilitation poses new challenges to the stomatognathic system, which alters masticatory function. Relatively little is known about the extent to which chewing differs between dentate subjects and completely or partially edentulous patients treated in various ways.^{6,14,15,19,28,41.}

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Edentulism is defined as the loss of permanent teeth and is believed to be caused by dental caries, periodontal disease, trauma and others. It is an indicator of both population health and the functioning and adequacy of a country's oral health care system and is associated with low education level and poor socioeconomic status.^{1,2}

The advances in the medical sciences have led to people living longer. Along with the increased life expectancy, there is a desire to live to the fullest with an esthetic appearance and functional rehabilitation. The patients who have lost their teeth are looking for custom made treatment modality in prosthetic rehabilitation. This helps in providing adequate masticatory, phonetic and esthetic function, simulating the natural dentition that does not jeopardize the remaining teeth,⁴¹ thereby ranging from a complete coverage single crown or a long span fixed dental prosthesis to a full mouth rehabilitation.⁵ Loss of teeth can be equated to an amputation, and gaps in the teeth are perceived as physical imperfections akin to missing body parts.⁹

Adult patients with varying severity of tooth loss can be rehabilitated by different types of fixed or removable constructions which are retained by the remaining natural teeth or dental implants, or in cases of edentulism, are supported directly by the oral mucosa.

At present, there exists three main methods which are used individually or in combination in order to replace lost teeth. The three methods are as follow:

1. A removable denture, which the patient can insert or remove.
2. A bridge retained by the natural teeth abutting the gap and which bears the replacement teeth.
3. Implants which are anchored in the jawbone and support a removable denture or fixed tooth-replacements.

Bite force is an important element of masticatory system.²³ The bite force is the ratio of the distance from the jaw joint which is the fulcrum or pivot point to the point of application, i.e. the biting versus the distance from the jaw joint to the muscle attachment which is the force required to close the jaw. This force results from the action of the jaw elevator muscles (in turn, determined by the central nervous system and feedback from muscle spindles, mechanoreceptors and nociceptors) modified by the craniomandibular biomechanics.

Masticatory performance is a cumulative contribution of various factors like bite force, severity of malocclusion, occlusal contact area, body loss of teeth, restorations, facial forms and other motor activities. Maximum bite force indicates the functional state of the masticatory system.⁷ Bite forces are correlated to diet, cranial design and are considered to be the key determinant of the masticatory function.

Factors including bite force and occlusal contact area, suggest that higher the bite forces and the larger the occlusal areas, the more efficient the mastication is. Bite force has also shown to be affected by a number of physiological and morphological variables such as craniofacial morphology, age, gender, periodontal support of the teeth, height and body weight, tempo-mandibular disorders pain, and dental status.²⁹

Other variables reportedly affecting the bite force are the type of recording devices, technique employed to measure the bite force, position of the sensor in the oral cavity, patient position, unilateral or bilateral measurements and magnitude of mouth opening during measurements.⁴

Patients and Methods:-

After obtaining the ethical clearance, subjects for the present study were selected amongst the patients who reported to the outpatient department of Oral and Maxillofacial Surgery, GITAM Dental College and Hospital, Visakhapatnam from June 2014 to March 2015 to evaluate the pre and post rehabilitation bite forces in completely and partially edentulous patients.

Details of the patients were recorded at the beginning. Bite forces prior and post rehabilitation were recorded. All selected patients were informed about the experimental nature of the study. Their cooperation was solicited. The effective mode of rehabilitation was determined on the basis of pre and post rehabilitation bite forces.



Bite force measurements were made using indigenous Bite Force Meter in 75 individuals belonging to different age groups. Follow up was done post rehabilitation. The maximum bite forces were assessed in the control group. Pre and Post rehabilitation bite forces were recorded in the study group which comprises complete denture, removable partial denture, fixed partial denture and implants.

The bite force meter consisted of a Wheatstone bridge assembly, instrument amplifier and a digital panel meter. An adjustable button is incorporated on the instrument for resetting the instrument reading to zero, at the start of each recording. This electronic device was connected to the bite force pads. The bite force pads were placed in the posterior 1st molar region on both right and left sides of the jaw. This was accomplished by instructing the subject to bite on the pads as the subjects were asked to remain seated with the head upright, looking forward, and in an unsupported natural head position throughout the trial refraining from extraneous movements. The force applied is seen on the bite force meter display. The high precision load cell and electronic circuit provided precise measurements.¹⁰

Results:-

In the present study, the most common age groups that the subjects underwent rehabilitation procedures were between 35-53 years. The mean age group was 43 years.

There was a significant increase in the post rehabilitation bite forces in males and females on both right and left side when compared to the pre rehabilitation bite forces in all the groups. However, the group comprising removable partial denture indicated a significant decline in the post rehabilitation bite forces in comparison to pre rehabilitation bite forces.

Paired Samples Statistics						
Group			Mean	N	Std. Deviation	p-value
complete denture	Pair 1	right	10.8140	15	5.78130	0.001
		rightafr	22.1247	15	10.57687	
	Pair 2	Left	12.3260	15	6.62137	0.003
		leftafr	23.9547	15	11.77417	
removable partial denture	Pair 1	right	216.8453	15	289.18050	0.269
		rightafr	130.1687	15	36.83493	
	Pair 2	Left	196.6040	15	253.47638	0.908
		leftafr	185.5500	15	221.86138	
fixed partial denture	Pair 1	right	105.8340	15	30.51702	0.000
		rightafr	142.3220	15	29.76522	
	Pair 2	Left	99.1333	15	32.25323	0.000
		leftafr	142.9213	15	35.02141	
Implants	Pair 1	right	263.4800	15	44.21017	0.000
		rightafr	296.7827	15	45.55500	
	Pair 2	Left	263.2633	15	42.46300	0.000
		leftafr	293.0387	15	43.53010	

Higher bite forces were recorded from patients who were rehabilitated by fixed partial denture whereas the bite forces from the patients who were rehabilitated with Implants were found to be the highest.

Discussion:-

As a result of rehabilitation of tooth loss, the patient's oral function gets restored and eventually the patient regains the prerequisite conditions for participating in social activities again.^{1,2} Specific improvements are described such as enjoyment of food, clarity of speech and attractive facial expression. Single tooth loss can be treated by a tooth-retained bridge, a resin-bonded retained bridge or an implant-retained crown. Few studies have shown that the survival of implant-retained crown constructions is over 90 percent and the risk of bone loss (>2mm) around the implant is small. Patients with more extensive tooth loss can be treated with tooth or implant-supported bridges. Around 95 percent of implant-supported bridges can be expected to survive after 5–10 years.⁵

Patients with long periods of edentia often lose more mandibular bone than those with a shorter period of edentia. Denture wearing is also very important in alveolar ridge resorption as the number of lower dentures worn is related with the period of edentia and alveolar ridge resorption. The individuals who wear their complete dentures continuously throughout the day and night, have more resorptive changes in the jaws when compared to those who wear dentures daily. The high success rate and consequently the widespread use of dental implants for prosthetic rehabilitation have led to revision of numerous aspects of the original treatment protocols.³ The aim of this report was to evaluate the patients' livelihood with varying degrees of tooth loss and their response to the type of rehabilitation with the perseverance oral quality of life that the currently available methods of rehabilitation have after 5, 10 and 15 years according to its efficiency.

Maximum bite force is a useful indicator of the functional state of the masticatory system and the loading of the teeth, and its recordings can be performed in a relatively simple way in the clinic or the department.²² A measuring device, essentially a bite force meter, is directed to a particular location, a bite point source of a specific tooth among the whole dentition and the bite force is measured.¹⁰

Comparison of bite forces between males and females on both right and left sides was done in the control group. The highest bite force was recorded on left side of females which was around 398 N. The left side of control group individuals was more significant when compared with the other groups. The right and left posterior regions did not show any significant difference in bite force. The mean bite force was around 350N on the right and 364N on the left side of the jaw. Few studies have shown that increase in the maximum bite force values was seen at the dentate side when compared to the rehabilitated side.⁸ There may be hormonal differences that contribute to the composition of muscle fibers in both males and females. However the age factor has got relatively a small influence on the bite force.⁴

Comparison of pre and post rehabilitation bite forces on right and left side of the jaw was done in all the study groups that comprised of complete denture, removable partial denture, fixed partial denture, and implants group.

In complete denture group, the pre rehabilitation bite forces was around 10N on right side and 12N on the left side that showed no statistical significant increase whereas post rehabilitation bite forces was around 22N on right side and 23N on left side that showed a statistical significant increase on the left side of the jaw when compared across all other groups. Hence, many studies have stated that, the stomatognathic system behaves functionally depending on the type of oral rehabilitation.⁵

In removable partial denture group, there was a mild difference between the pre and post rehabilitation bite forces in the study group. Pre rehabilitation bite forces was around 216N on right side and 196N on left side where as post rehabilitation bite forces was around 130N on right side and 185N on left side. Post rehabilitation, bite forces were higher on the left side of females. Although studies on the influence of gender on maximum bite force have shown that in young adults, the females showed greater values when compared to males. Patients with mandibular anterior or posterior natural teeth have greater resorption of the edentulous maxilla than patients with mandibular complete dentures or patients with natural teeth. Hence studies have concluded that the cause of resorption of maxillary and mandibular bony structures was due to removable partial denture and mostly seen in removable partial denture wearers.³

In fixed partial denture group, the pre rehabilitation bite forces was around 105N on right side and 99N on left side where as post rehabilitation bite forces was around 142N on both left and right side as well. Thus, no statistical significance was elicited in both the pre and post rehabilitation stage. Higher bite force values were recorded in females on the right side post rehabilitation. It is believed that female adults between 13 and 20 years of age exhibit

a greater muscle thickness¹⁹ whereas males have a gradual increase in muscle thickness that eventually occurs over time.³⁹ Many studies have proven that the occlusal force would be higher on the preferred chewing side and no statistical significance of occlusal force was found in relation to the quadrants.¹⁵ As masticatory performance was mainly affected by occlusion factor the greater areas of contact and near contact provided better occlusal stability (tooth alignment and molar bite force) which helped in allowing the masticatory function to be more efficient.²⁷

In the implant group, the pre rehabilitation bite forces was around 263N on right side and left side as well, whereas the post rehabilitation bite forces was around 296N on the right side and 293N on left side. The pre as well as post rehabilitation stages exhibited an excellent increase in the bite force when compared across all the groups. A statistically significant difference was seen between males & females post rehabilitation on the left side for implant group. On comparing across the other rehabilitatory groups, higher bite force values were elicited in the implant group individuals. Several studies have concluded that, higher bite force and masticatory efficiency was seen in individuals rehabilitated with implants and single crowns. An improved function was seen in those individuals rehabilitated with implant supported mandibular over denture when compared to those rehabilitated with conventional complete dentures.^{5,20} The biting efficiency was affected by the postoperative occlusal plane angle.²³ A positive correlation was found between muscle function and tooth position in few studies.²⁸ The biting force measured for the ipsilateral and the contralateral pair of teeth has always shown higher values in the posterior pair of teeth.⁴¹ A minimum period of twelve weeks is required for the tissues to adapt to a new vertical dimension as the bite force measurements were found to give consistent readings after twelve weeks.²² A High score of satisfaction and quality of life has been found in patients rehabilitated with implant supported prosthesis.^{5,13}

Conclusion:-

Implants exhibited the maximum bite force in comparison with all the other groups, due to which it stands as one of the most successful and effective mode of rehabilitation. Thus it can be advised that tooth or teeth loss can be rehabilitated with either implant or implant based treatment options as it achieves the same bite force as the natural teeth.

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