

## Occlusal Rehabilitation: A Review

Dr. Siddhartha Bhowmick<sup>1\*</sup>, Dr. Md Siraj UR Rahman<sup>2</sup>, Dr. Pallavi Luthra<sup>3</sup>, Dr. Md Miftah ur Rahman<sup>4</sup>, Dr. Shalini Singh<sup>5</sup>, Dr. Elaproli Mallikarjun<sup>6</sup>

<sup>1</sup>Senior Lecturer, Dept of conservative and endodontics, Awadh Dental College and hospital Jamshedpur, Jharkhand, India

<sup>2</sup>Assistant. Professor, Dept of Prosthodontics, Govt Dental College and Hospital, Afzal Gunj Hyderabad, Telangana, India

<sup>3</sup>Senior Lecturer, Department of Prosthodontics, Sri Sai College of dental surgery, Vikarabad, Telangana, India

<sup>4</sup>PG Student, Department of Prosthodontics Crown & Bridge, Sri Sai College of Dental Surgery, Vikarabad, India

<sup>5</sup>MDS, Consultant Conservative Dentist & Endodontist, Bhandup West, Mumbai, Maharashtra, India

<sup>6</sup>Assistant Professor, Dept. Of Conservative Dentistry & Endodontics, GSL dental college, Rajahmundry, Andhra Pradesh, India

DOI:10.21276/sjodr.2019.4.8.3

| Received: 21.06.2019 | Accepted: 22.07.2019 | Published: 15.08.2019

\*Corresponding author: Dr. Siddhartha Bhowmick

### Abstract

Planning and executing the restorative rehabilitation of a decimated occlusion is probably one of the most intellectually and technically demanding tasks facing a restorative dentist. The term "occlusal rehabilitation has been defined as the restoration of the functional integrity of the dental arches by the use of inlays, crowns, bridges and partial dentures". Occlusal rehabilitation therefore involves restoring the dentate or a partially dentate mouth. The aim is to provide an orderly pattern of occlusal contact and articulation that will optimize oral function, occlusal stability and esthetics. Occlusal adjustment by grinding may be required, as part of the rehabilitation but does not constitute rehabilitation per se. In this review occlusal rehabilitation is discussed in the context of cases where restorations are supported by natural teeth and doesn't include the restoration of the fully edentulous arch or maxillofacial defects, nor does it include the use of osseointegrated implants.

**Keywords:** Rehabilitation, Occlusion, Review.

**Copyright @ 2019:** This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

## INTRODUCTION

### Indications for Occlusal Rehabilitation

The reasons for undertaking occlusal rehabilitation may include the restoration of multiple teeth, which are missing, worn, broken-down or decayed. Increasingly occlusal rehabilitation is also required to replace improperly designed and executed crown and bridge work. In certain circumstances treatment of temporomandibular disorders may also be considered an indication for rehabilitation, but great caution is advisable in such cases. Regardless of the clinical reason, the decision to carryout any treatment should be based upon achieving oral health, function, esthetics and comfort, and treatment should be planned around these rather than the technical possibilities. If these goals are to be achieved certain biological considerations are necessary when planning and carrying out occlusal rehabilitation [1-3]. They are

- The indications for reorganizing the occlusion
- The choice of an appropriate occlusal scheme
- The occlusal vertical dimension
- The need (or otherwise) to replace missing teeth

- The effects of the material used on occlusal stability control of parafunction and TMD

### The Indications for Reorganizing Occlusion

When undertaking relatively small amounts of restorative treatment, for example up to two or three units of crown and bridge work, it is often acceptable, and it is often advisable to adopt a confirmative approach that is to construct the restoration to conform with the patient's existing intercuspal position. The alternative strategy is to reorganize the occlusion by establishing a new occlusal scheme around a stable condylar position. The condylar position usually chosen is termed "centric relation" (CR) [4].

The decision to re organize a patient's occlusion may be made on the grounds either that the existing IP is unacceptable and needs to be changed, or where a very large amount of treatment is to be undertaken and the operator has the opportunity to optimize patient's occlusion. The decision should (and can) only be made after a detailed and careful examination of the occlusion, preferably with the use of accurate study casts mounted-in a semi adjustable

articulator in the retruded arc of closure. Mounted casts should allow the discrepancy (slide) between CR and IP to be analyzed as vertical, horizontal and lateral components both at tooth and condylar level. Moreover, adjustments can be tried and potential restorations waxed allowing the feasibility and difficulty of reorganization to be judged properly [5]. It must be borne in mind that jaw movement will be simulated only partially by any type of articulator. Nevertheless, the semi adjustable articulators are an invaluable supplement to diagnosis and can save time with occlusal adjustments when restorations are fitted. Reorganization maybe considered when the existing IP is considered unsatisfactory for any of the following reasons:

- Repeated fracture or failure of teeth or restorations.
- Lack of interocclusal space for restoration.
- Trauma from occlusion.
- Unacceptable function.

### **Which Patients Should Not Be Treated by Full Mouth Rehabilitation?**

Frequently, friends and relatives of one's rehabilitation patients will request similar treatment. There are many malfunctioning mouths that do not need extensive dentistry and have no joint symptoms. These cases are best left alone. Some mouths that have the potential to break themselves down, never actually produce the destruction, for some reason. We are not justified in prescribing a full mouth rehabilitation unless there is definite evidence of tissue breakdown. One may argue, as many have, that it should be undertaken as a preventive measure. But there are many malfunctioning mouths that do not break down, proving that we cannot predict such things. If there is need for extensive dentistry, then by all means it should be carefully correlated to the rest of the mouth by complete rehabilitation. Some times one or two "good" teeth may have to be operated on in order to satisfactorily accomplish our objective. Ideally, dental procedures should be directed toward the prevention of such conditions: in short, no pathology -no treatment [6, 7].

### **Functional Aspects of Complete Mouth Rehabilitation**

A Biologic and Functional approach to restorative dentistry is essential for the satisfactory performance and fulfillment of those requisites basic to Prosthodontics. Accordingly, the masticatory organ must be considered as a functional consolidated unit, with proper attention being directed to all the elements that comprise this unit. All functional factors are interrelated, and proper regard for each aspect is essential, if the restoration and maintenance of the health of the entire functioning mechanism is to be a realization. Consequently, a comprehensive study and practical approach must be directed toward the interrelation of the teeth and their supporting periodontal structures, the myofunctional aspects of

mastication, the intricacies of vertical dimension, freeway space, centric relation, and centric occlusion [8]. The objective of complete mouth rehabilitation is the reconstruction, restoration, and maintenance of the health of the entire oral mechanism. The accomplishment of this goal requires an understanding and utilization of all available dynamic potentials. Complete mouth rehabilitation is a dynamic functional problem, and embodies the correlation and integration of all component parts into one functioning unit. The aim and endeavor, therefore, must be reconstruction and rehabilitation of the whole satisfying all the related factors [9]. The science of complete mouth rehabilitation rests upon three proved and accepted fundamentals: namely, the existence of a physiologic rest position of the mandible. Which is a constant; the recognition of a variable vertical dimension; and, finally, the acceptance of a dynamic, functional centric occlusion, these principles have been basic in the development of the myofunctional concept of mastication and have furthered the development of the physiologic approach to occlusion [10].

### **Treatment Planning**

Before we begin treatment, it is important to have a complete plan of operation. The patient usually wants to know just what we are going to do. so that he may plan his life accordingly. He should be told the probable length of time involved in the treatment, the length and frequency of the appointments, and the possible indisposition. A person in business may not want to return to his office feeling numbness or discomfort after a two-hour session. He may therefore prefer to have his appointment in the afternoon in order that he may return directly home. Other patients would rather have the work done early in the morning to get it out of the way. For the best dentist-patient relationship, all these things should be considered. Some patients have great distances to travel. We should plan their treatments and appointments with a view to keeping the number of trips to a minimum. Where patients come from out of town, our laboratory schedule should be arranged so that the necessary work can be finished in a reasonable time. In most cases it is advisable to give the patient a general outline -not the particulars -of the planned procedure. The details will serve no purpose except possibly to confuse, scare, or impress him. He will be more impressed, however, by the results. Occasionally a patient is interested and intelligent enough to want to know more about the projected work. In such instances, a more detailed exposition of what is involved may help the general because of patient education, since these patients may discuss the type of treatment with their family and friends. In any event, it is extremely important that we outline exactly what we plan to do [11-15].

### **Preparation of the Mouth for Rehabilitation**

Having completed the necessary diagnostic procedures, having decided that complete oral

rehabilitation is indicated, and having made our treatment plan, we must now prepare the mouth for the restoration [16]. Depending upon our findings, we will remove or have removed any infective processes such as retained roots, impactions, unimportant devitalized teeth, and the like. Today, with proper endodontic treatment, the retention of questionable strategic teeth is possible. However, since these teeth are potential liabilities from the standpoint of the complete treatment, often it is wise to include in our restoration plan the possibility of their loss at a subsequent time. In other words, we should be prepared for such contingencies as fractures, undetected decay, and recurrent infection. Whenever feasible, we should provide insurance against fracture by the use of a metal post and/or collar of metal. As with most general rules, exceptions are sometimes in order; for example, the retention of an impacted third molar. If its removal would jeopardize a second molar needed for a bridge abutment or the removal of a devitalized strategic root in a patient suspected of having a focus of infection. Occasionally, a perfectly good tooth may have to be sacrificed because of its relation to the other teeth. It is not wise to compromise the result of the entire effort just to save a single tooth" [17-20].

#### **Pankey-Mann Schuyler Philosophy of Complete Rehabilitation**

One of the most practical philosophies for occlusal rehabilitation is the rationale or treatment that was originally organized into a workable concept by Dr. L.D. Pankey. Utilizing the "Principles of occlusion" espoused by Dr. Clyde Schuyler. Dr. Pankey integrated different aspects of several treatment approaches into an orderly plan for achieving an optimum occlusal result in minimum stress on the patient or the dentist, Dr Arvin Mann Contributed to the concept by working with Dr. Pankey in the development of the first specialized instrument for developing the occlusal plane. The instrument became known as the Pankey-Mann instrument, and even though it has long ago been replaced by a simpler system the over all concept of treatment is still referred to as the Pankey-Mann-Schuyler Philosophy (abbreviated to P.M.S) [21]. Contrary to some popular misconceptions, the P.M.S. approach is not so much a technique as it is a philosophy of treatment that organizes the reconstruction of an occlusion into a sequence of goals that must be fulfilled. It is true that certain techniques have become closely associated with the P.M.S. philosophy, but it is also true that there has been a continuous trend toward improving and simplifying almost every aspect of treatment without noticeably changing the basic philosophy of treatment. Furthermore, the overall concept of treatment is not limited to any specific instrument or method. There is consideration flexibility of treatment within the P.M.S. philosophy as long as its goals of optimum occlusions are not sacrificed [22, 23]. Since its inception, the philosophy has had as its goal the fulfillment of the

following principles of occlusion as advocated by Schuyler:

- A static coordinated occlusal contact of the maximum number of teeth when the mandible is in centric relation.
- An anterior guidance that is in harmony with function in lateral eccentric position on the working side.
- Disclusion by the anterior guidance of all posterior teeth in protrusion.
- Disclusion of all nonworking inclines in lateral excursions
- Group function of the working side inclines in lateral excursions.

Many P.M.S, advocates now vary the fifth goal of working side group function to permit more flexibility in distributing lateral stress. In order to accomplish these goals, the following sequence is advocated by the P.M.S. philosophy:

- PART I. Examination, diagnosis, treatment planning, prognosis
- PART 2. Harmonization of the anterior guidance for best possible esthetics, function, and comfort
- PART 3. Selection of an acceptable occlusal plane and restoration of the lower posterior occlusion in harmony with the anterior guidance in a manner that will not interfere with condylar guidance.
- PART 4. Restoration of the upper posterior occlusion in harmony with the anterior guidance and condylar guidance. The functionally generated path technique is so closely allied with this part of the reconstruction that it may almost be considered part of the concept.

Bach one of these steps has undergone continuous metamorphosis as techniques to accomplish the goal have been improved and modified with a wide choice of sophisticated options. One of the most impressive advantages of P.M.S. is the latitude of sophistication it permits. Treatment modes within the concept can be varied from the simplest techniques for the beginning restorative dentist to the most precise details of the master reconstructionist. The determination of an acceptable occlusal plane was first simplified by Fillstrc and then further improved by Broairick. The Broadrick occlusal Plane Analyzer is so simple to use that it has become the standard method of analyzing occlusal plane for posterior occlusal reconstruction. The P.M.S. philosophy is not limited to any specific instrument. Swanson and Wipf adapted the Broadrick "flag" for their temporomandibular joint stereographic articulator and Fillastre developed a device for the same instrument that determines ridge and groove directions on the lower occlusal wax patterns. The advantages of the technique are many. Some of the major ones are as follows [24-26];

- It is possible to diagnose and plan treatment for the entire rehabilitation before preparing a single tooth.
- It is a well-organized, logical procedure that progresses smoothly with less wear and (car on the patient, operator, and technician.
- There is never a need for preparing or rebuilding more than eight teeth at a time.
- It divides the rehabilitation into separate series of appointments. It is neither necessary nor desirable to do the entire case at one time.
- There is no danger of "getting at sea" and losing the patient's present vertical dimension. The operator knows exactly where he is at all times.
- The functionally generated path and centric relation are taken on the occlusal surface of the teeth to be rebuilt at the exact vertical dimension to which the case will be constructed.
- All posterior occlusal contours are programmed by and are in harmony with both condylar border movements and a perfected anterior guidance.
- There is no need for time-consuming techniques and complicated equipment.
- Laboratory procedures are simple and controlled to an extremely fine-degree by the dentist.

The Pankey-/Mann-Schuyler philosophy of occlusal rehabilitation can fulfill the most exacting and sophisticated demands. The operator understands the goals of optimum occlusion. And it can achieve these goals with great simplicity and orderliness of technique, it can be combined with other techniques and it can be adapted to any occlusal problem. An understanding of the P.M.S. philosophy is a tremendously valuable aspect of the complete dental education.

### **The Principles of Obtaining Occlusion in Occlusal Rehabilitation**

The restoration of occlusion requires a correlation and integration of biologic factors, mechanical principles, and esthetic requirements with treatment procedures. The objectives of such dental service may be satisfied to a high degree by several excellent methods of approach. The unit area concept in the restoration of occlusion for the individual rehabilitation problem should not be confused with segment of the arch techniques. The construction of fixed partial denture restorations has been influenced largely by the materials available through the years [27]. Within recent years, the segment of the arch procedure has been generally discarded in favor of techniques with complete arch casts. This technical improvement has been responsible for the elimination of many of the inaccuracies which formerly

complicated the restoration of occlusal harmony, even in short-span restorations.

### **The Unit Area Concept**

With this background, unit area concept in occlusal rehabilitation can be differentiated from a mere technical procedure used in the construction of fixed "bridges." Basically, the unit area concept is the original method of handling the involved problems in occlusal reconstruction improved by many refinements developed in clinical dentistry. The improvements have not been all technical in nature since emphasis has continued to be placed on the value of conservative dental treatment for the patient. Further, it is not necessarily the most direct approach to the treatment for the total restorative problem. However, the benefits realized are the preservation and use of jaw relation landmarks, the conservation of tooth structure in the choice of retainers, the construction of the restorations by the dentist even when auxiliary technical assistance is not available, the simplified correction of inaccuracies, and the more efficient management of complicated restorative problems [28].

### **Classification and Treatment**

There are four classifications of occlusal rehabilitation and situations, and each requires a different type of treatment: (1) The curve of Spee (occlusal curvature of the posterior teeth) and the incisal guidance are acceptable as presented by the patient, but the posterior teeth need rehabilitation. The treatment plan includes the restoration of the lower posterior teeth to the patient's curve of Spee as presented. Then the upper posterior teeth are restored by the functionally generated path technique. (2) The curve of Spee (occlusal curvature of the posterior teeth) is irregular, but the incisal guidance is acceptable. The treatment plan involves the restoration of the lower posterior teeth to a more desirable curvature with the use of the P.M. instrument. Then the upper posterior teeth are restored with the functionally generated path technique and the existing incisal guidance. (3) The curve of Spee (curvature of the occlusal plane of the posterior teeth) and the incisal guidance are both unacceptable. The treatment plan involves: (a) the correction of the incisal guidance by restoring the upper anterior teeth by means of jackets or pinlays as indicated, (b) the restoration of the lower posterior teeth to a more desirable occlusal curvature, using the P.M. instrument, and (c) the restoration of the upper posterior teeth with the use of the functionally generated path technique. (4) The curve of Spee (curvature of the occlusal plane of the posterior teeth) and the incisal guidance are not acceptable, and the upper and lower anterior teeth need rehabilitation. The treatment plan involves: (a) the restoration of all the lower anterior teeth, (b) the restoration of the upper anterior teeth and the incisal guidance, (c) the restoration of the lower posterior teeth to a more acceptable occlusal curvature with the P.M. instrument, and (d) the restoration of upper posterior



teeth with the use of the functionally generated path technique [29].

### **Rationale and Technique of Biomechanical Occlusal Rehabilitation**

"A physiologic occlusion is one in which the relation between the teeth and the periodontal tissues is such that under occlusal stress no injury is produced by them and further, the tissues are best able to withstand the forces of occlusion, without the initiation of pathologic changes in the periodontium."

All teeth are subjected to both vertical and horizontal stresses. The steeper the cusp, the greater the horizontal loading. Vertical loading distributes the stress over the entire alveolus and may be increased considerably without overloading. Horizontal loading acts on the periodontal membrane and bone regionally and frequently exceeds the normal limits of the tissues. Optimum occlusion is one in which the relation between the teeth and the periodontal tissues is such that under occlusal stress the most favorable loading is achieved, thereby fostering the biologic maintenance of the periodontium.

### **Bilateral Balance versus Optimum Loading**

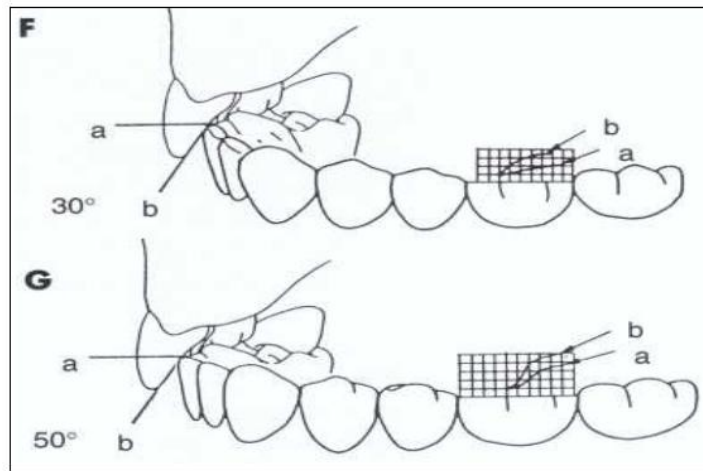
The question of bilateral balance in the natural dentition is still a controversial one. Those who are opposed argue that mastication is a unilateral process, that bilateral balance rarely occurs in nature, that many healthy dentitions present without bilateral balance and clinch their argument with the pithy comment of Prime, "Enter bolus, exit balance." Jankelson's recent work promises to resolve this hitherto academic question. He concludes. "The evidence strongly suggests that centric occlusion is the only tooth contact of any significance that occurs during stomatognathic function. Evidence of eccentric tooth balance during eating was not found. There was no evidence that balance of teeth eccentric positions is a physiologic necessity, or that lack of eccentric balance is less conducive to masticatory function". Although bilateral balance is not essential to masticatory function, it is a most desirable adjunct to occlusal reconstructions. Here we are dealing with mutilated dentitions and periodontal breakdown, and bilateral balance serves to distribute the occlusal loading over more teeth and greater saddle area. This distribution of loading is probably more important during the nonchewing movements than in actual mastication. We know that actual chewing function occupies but one hour a day and we have also learned

from the work of Hildebrand, Jankelson, and others, that even in chewing, teeth make only occasional contact. However, in the twenty-three remaining hours of the day, the teeth contact innumerable times: in swallowing, during conversation, and intensional movements. How many of our patients requiring occlusal reconstruction are completely free of emotional tension which frequently is attended by clenching, tapping, or gritting of the teeth, although perhaps unconsciously? It is during these twenty-three hours of nonchewing and tensional contacts that the teeth are subjected to repeated stress, and it is during this time that bilateral balance serves to mitigate that stress by wider distribution of it [30]. Thus bilateral balance is essential to achieving optimum loading of our reconstructed occlusion. (Note: Bilateral, balance, as it is used here implies contact of all the posterior teeth and not a single balancing point or area.)

### **The Optimum Occlusal Pattern**

From the preceding it would follow that the optimum occlusal pattern for rehabilitation is the most shallow intercuspation consistent with bilateral balance.

What can we do to influence and achieve such an occlusal pattern? In virtually every reconstruction case, we find it necessary to re-establish correct, centric relation and/or to restore lost vertical dimension. Both of these changes cause the mandible to be brought downward, decreasing the vertical overlap. This results in a decrease in the degree of inclination of the incisal guidance. Judicious grinding and reshaping of the anterior teeth, or rebuilding the anterior-teeth can achieve further reduction in the jangle of the incisal inclination. Let us now see how by control of this single factor (the angle of the incisal guidance) we can drastically influence cusp height. Fig-1 illustrates a comparative study of two different incisal guide angles with the same condyle angle, in Fig.1.G (with a 50 degree incisal guide angle) we find that in order to achieve occlusal harmony, we must build upper lingual cusps (and conversely, lower buccal cusps) ranging from 32.5 to 41 degrees, and; also we must build upper buccal cusps (and, conversely, lower lingual cusps) ranging from 15.5 to 32.5 degrees. In Fig-1 with a 0 degree incisal guidance and the same condylar inclination, we find that we need only build upper lingual cusps (and conversely, lower buccal cusps) ranging from 17.5 to 9 degrees, and also that all the upper buccal cusps and all the lower lingual cusps require a 0 degree inclination [31].



**Fig-1: Illustrates two different incisal guide angles**

Decalogue for occlusal rehabilitation:

- Occlusal rehabilitation is a radical and serious procedure. It should not be undertaken merely because the occlusal relationship existing does not conform to preconceived concepts of the normal or ideal.
- The ultimate standard of normal is functional adequacy. In the presence of functional adequacy, conservative treatment is indicated.
- Where pathologic changes in the periodontium are in evidence, and where mutilation and/or occlusal disharmonies are present, mouth rehabilitation is indicated.
- Where extensive prosthesis is necessary, occlusal reconstruction is indicated although no pathosis is evident. It will enhance the success of the treatment.
- The final judgment of success must be in terms of how well and for how long the remaining teeth and supporting structures are preserved.
- There is no evidence that an anatomic articulation is a physiologic necessity. Chewing efficiency can exist over a wide range of occlusal forms and types of occlusion.
- Bilateral balance, although not essential to masticatory function, is de-sirable in that it serves to mitigate the stresses of nonchewing and tensional tooth contacts by their wider distribution.
- The optimum occlusal pattern for occlusal reconstruction is the most shallow cuspatation consistent with bilateral balance.
- A reconstructed occlusion cannot be regarded as static; a tolerance factor to permit simple correction for reorganization and wear is desirable to safeguard the result.
- Optimum occlusion {where the relation between the teeth and the periodontal tissues is such that under occlusal stress the most favorable loading is achieved thereby fostering the biologic maintenance of the periodontium) is the goal of occlusal rehabilitation.

### Classification and Technique of Treatment

The conditions which require occlusal reconstruction may be classified in three categories:

- Class A: Condyles in normal resting position in the fossae, loss of vertical dimension due to missing teeth, drifting of teeth or abnormal wear of teeth.
- Class B: Condyles in inferior and anterior (mesial) relation in the fossae, mutilation of the teeth, loss of vertical dimension or increase of vertical dimension due to eccentric contact.
- Class C: Condyles in superior and posterior (distal) relation in fossae with loss of vertical dimension.

### SUMMARY

#### Objective of Treatment

Having decided that a mouth requires the full treatment, what is our objective? All these patients have one problem in common: stress and strain. Usually the stress and strain is due to malfunction or to poorly related parts of the oral mechanism. Occasionally, undue stress and strain on the oral mechanism is the result of an emotional disturbance. Whatever the cause, whatever the reason, the common denominator seems to be stress. Our problem, then, resolves itself into one of minimizing these stresses so that, they are not destructive. The stresses should fall within the capability of the tissues to withstand them and maintain a state of health. To accomplish this objective to the fullest degree possible, it is essential to have an intimate knowledge and a very clear understanding of the masticatory mechanism, of certain principles and forces. It requires knowledge of how the oral mechanism is built and how it functions. If excessive stresses are involved, we must reduce or minimize them so that they will not be destructive. Granted that the muscles of the oral mechanism can exert a certain amount of force, in order to prevent this stress from being destructive the best thing to do is to distribute it evenly over as great an area as possible: over as many teeth as possible, over the temporomandibular joints,

over as much tissue as possible, and over as many cells as possible. This approach makes sense. A given force distributed over as great an area as possible reduces the stress per unit so that it can be tolerated by the tissues. Aging tissues may not be able to withstand the same stress as younger tissues. This is why a malfunction is frequently tolerated at a younger age. Our problem, then, becomes one of how best to distribute this given force or stress [32].

## CONCLUSION

The oral mechanism consists primarily of the temporomandibular joints, the teeth and their supporting structures, and the muscles of mastication. We are concerned with the joints and the supporting structures. The teeth are the means by which the stresses are going to be directed or transmitted. We know from our anatomy and physiology that the temporomandibular joint is a stress-bearing joint that the supporting structures (bone) of teeth are designed to withstand stress. The objective is to distribute these stresses equally between the joint, tissues and the supporting structures. Teeth will be the means by which the forces are distributed.

## REFERENCES

- Atwood, D. A. (1956). A cephalometric study of the clinical rest position of the mandible: Part I. The variability of the clinical rest position following the removal of occlusal contacts. *Journal of Prosthetic Dentistry*, 6(4), 504-519.
- Atwood, D. A. (1968). A critique of research of the posterior limit of the mandibular position. *Journal of Prosthetic Dentistry*, 20(1), 21-36.
- Atwood, D. A. (1958). A cephalometric study of the clinical rest position of the mandible: Part III: Clinical factors related to variability of the clinical rest position following the removal of occlusal contacts. *Journal of Prosthetic Dentistry*, 8(4), 698-708.
- Atwood, D. A. (1956). A cephalometric study of the clinical rest position of the mandible: Part I. The variability of the clinical rest position following the removal of occlusal contacts. *Journal of Prosthetic Dentistry*, 6(4), 504-519.
- Basler, F. L., Douglas, J. R., & Moulton, R. S. (1961). Cephalometric analysis of the vertical dimension of occlusion. *Journal of Prosthetic Dentistry*, 11(5), 831-835.
- Berry, H. M., & Hofmann, F. A. (1959). Cineradiographic observations of temporomandibular joint function. *Journal of Prosthetic Dentistry*, 9(1), 21-33.
- Binkley, T. K., & Binkley, C. J. (1987). A practical approach to full mouth rehabilitation. *The Journal of prosthetic dentistry*, 57(3), 261-266.
- Guichet, N. F. (1977). Biologic laws governing functions of muscles that move the mandible. Part I. Occlusal programming. *The Journal of prosthetic dentistry*, 37(6), 648-656.
- Boos, R. H. (1956). Physiologic denture technique. *Journal of Prosthetic Dentistry*, 6(6), 726-740.
- Boucher, D. O. (1961). Current status of prosthodontics. *Journal of Prosthetic Dentistry*, 10:418-419.
- Boucher, L. J., Zwemer, T. J., & Pflughoeft, F. (1968). Can biting force be used as a criterion for registering vertical dimension? Vertical dimension in edentulous patients. *Journal of Prosthetic Dentistry*, 19:230.
- Boucher, L. J., Zwemer, T. J., & Pflughoeft, F. (1959). Can biting force be used as a criterion for registering vertical dimension?. *The Journal of Prosthetic Dentistry*, 9(4), 594-599.
- Braly, B. V. (1966). A preliminary wax up as a diagnostic aid in occlusal rehabilitation. *The Journal of Prosthetic Dentistry*, 16(4), 728-730.
- Brill, N. (1957). Reflexes, registrations, and prosthetic therapy. *The Journal of Prosthetic Dentistry*, 7(3), 341-360.
- Broderson, S. P. (1978). Anterior guidance--the key to successful occlusal treatment. *The Journal of prosthetic dentistry*, 39(4), 396-400.
- Broderson, S. P. (1978). Anterior guidance--the key to successful occlusal treatment. *The Journal of prosthetic dentistry*, 39(4), 396-400.
- Bronstein, B. R. (1954). Rationale and technique of biomechanical occlusal rehabilitation. *Journal of Prosthetic Dentistry*, 4(3), 352-367.
- D'Amico, A. (1961). Functional occlusion of the natural teeth of man. *Journal of Prosthetic Dentistry*, 11(5), 899-915.
- Dawson, P. E. (1974). *Evaluation, diagnosis, and treatment of occlusal problems* (p. 50). St. Louis: Mosby.
- DiPietro, G. J., & Moergeli Jr, J. R. (1976). Significance of the Frankfort-mandibular plane angle to prosthodontics. *The Journal of prosthetic dentistry*, 36(6), 624-635.
- El Aramany, M. A., George, A. W. Scott, R. H. (1965). Evaluating the needle point tracing as a method for determining centric relation. *Journal Prosthet Dent*, 15: 1043.
- Fayz, F., Eslami, A., & Graser, G. N. (1987). Use of anterior teeth measurements in determining occlusal vertical dimension. *The Journal of prosthetic dentistry*, 58(3), 317-322.
- Gill, J. R. (1952). Treatment planning for mouth rehabilitation. *The Journal of Prosthetic Dentistry*, 2(2), 230-245.
- Glickman, I., Haddad, A. W., Martignoni, M., Mehta, N., Roeber, F. W., & Clark, R. E. (1974). Telemetric comparison of centric relation and centric occlusion reconstructions. *The Journal of prosthetic dentistry*, 31(5), 527-536.

25. Goldman, I. (1952). The goal of full mouth rehabilitation. *The Journal of Prosthetic Dentistry*, 2(2), 246-251.
26. Goteen, L. F., & Shaw, A. F. (1984). Use of leaf gauge in diagnosis & therapy. *Quintessence Int*, 6:611.
27. Jones, S. M. (1963). The principles of obtaining occlusion in occlusal rehabilitation. *Journal of Prosthetic Dentistry*, 13(4), 706-713.
28. Guichet, N. F. (1977). Biologic laws governing functions of muscles that move the mandible. Part I. Occlusal programming. *The Journal of prosthetic dentistry*, 37(6), 648-656.
29. Heinlien, W. D. (1980). Anterior teeth: Esthetics and function. *Journal Prosthet Dent*, 44:389-393.
30. Hobo, S., & Takayama, H. (1989). Effect of canine guidance on the working condylar path. *International Journal of Prosthodontics*, 2(1):73-79.
31. Hobo, S., & Takayama, H. (1988). A new system for measuring condylar path and computing anterior guidance: Part I. Measuring principle. *International Journal of Prosthodontics*, 1(1):99-106.
32. Hobo, S., & Mochizuki, S. (1983). A kinematic investigation of mandibular border movement by means of an electronic measuring system. Part I: Development of the measuring system. *The Journal of prosthetic dentistry*, 50(3), 368-373.