OCCLUSION IN THE IMPLANT RESTORATIONS OF
THE COMPLETE EDENTULOUS MANDIBLE

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Abstract: The analysis of the biomechanical aspects plays a major part in the design of the treatment plan. Thus, this article will illustrate through accurate pictures and through a clinically solved case, a few aspects related to the design of the implantoprosthetic treatment, according to the existing particularities in the completely edentulous mandible.

Keywords: occlusion, implant restoration, completely edentulous mandible

Rezumat: Analiza aspectelor biomecanice are un rol important în conceperea planului de tratament, astfel, în cadrul acestui articol vor fi exemplificate prin scheme clare și un caz soluționat clinic câteva aspecte legate de conceperea tratamentului implanto-protetic, luând în calcul particularitățile existente în edenția totală mandibulară.

Cuvinte cheie: ocuzie, restaurări pe implante, edențație totală mandibulară

Notions which the biomechanics of the Dentomaxillary Apparatus is based on

Mandibular dynamics is a motion act achieved with the help of the temporomandibular joint and of the mobilising muscles of the mandible.

According to Posselt, the basic mandibular movements are:

- Opening and closing the oral cavity
- Protrusion and return movements with dental contact
- Retrusion and return movements with dental contact

By functionality, the mandibular movements are:

- Functional movements which take part in the functions of the dentomaxillary Apparatus (mastication, deglutition, phonation)
- Para-functional movements, if present, such as those encountered in Bruxism

In mastication, the forces are transmitted to the bone through the teeth and the periodontium. The intensity of these forces depends on the strength of the muscular contraction, on the consistency of the food and on the status of the dental arches.

The mastication forces are mostly vertical and are usually of 20-30 P.S.I. The effective mastication time is of 9-12 minutes/24 hours, and the mastication and deglutition one is of 30 minutes /24 hours.

In the mastication and deglutition act, the lingual and the perioral forces also take part, having a longer action and a predominant horizontal direction. They are maximum in deglutition: 3-5 P.S.I.

In the mandible, the trabecular system of the alveolar bone comes together in the top extremity of the dental alveoli, joining at this level with the trabecular system of the base bone and heading for the mandibular angle.

The basic trabecular system also depends on the muscular insertions, its structure being defined according to their action. It joins the trabecular system of the alveolar bone with the one emerging from the condile and from the coronoid apophyse. The trabecular system crosses with the one on the opposite side.

There are three major types of forces which can stress the alveolar bone: the compression, traction and scissoring forces, the last two types being harmful. The forces with the most harmful effect are generated by the presence of the parafunctions, such as bruxism.

The bruxism is defined as a parafunction materialised through the rubbing and/or clutching of the teeth from the two arcades.

Biomechanic particularities in the implant-prosthetic treatment

Generally the biomechanic studies supervise the response of the bone, the tooth or the implant when they are loaded with a mechanical weight.

For the success of the implant prosthetic treatment, there are two fundamental biomechanical reasons which must be accomplished:

- The axial distribution of the forces over the implant and the bone
- Obtaining a functional occlusion through the prosthetic restoration

This functional occlusion allows itself a proper distribution of the forces over the implant and the bone.

The biomechanical reasons determine within an implant prosthetic treatment plan the following features:

- The topography of the implants
- The length of the implants
- The diameter of the implants
- The number of the implants
- The material out of which the prosthetic work will be done
CLINICAL ASPECTS

- The occlusal reconstruction

  The direction and intensity of the forces which act in the area of the prospective prosthetic work will be carefully observed. In the case of bruxism, it must be definitely stopped before introducing the implant.

  The biomechanics of the dentomaxillary apparatus in the oral implantology is closely connected to the conception and execution of the prosthetic works placed on the implants. The physiological transmission of the forces at the level of the implants and the periimplant bone is observed.

  Unlike the natural teeth where the periodontium has adapted to the functional forces which act upon it, in the case of the dental implants, this periodontium is missing. Consequently the forces will be transmitted directly to the bone without being reduced by the periodontal ligaments.

  After the action of a force on a natural tooth, it comes back progressively in the initial position once the force has stopped.

  In exchange, the same occlusal forces applied this time at the level of the implant within the bone create a different effect. Due to the lack of the marginal periodontium, the implants have a much smaller physiological mobility. The vertical physiological mobility of the implant is of 5-8 microns, and the horizontal one is of 10-50 microns. This physiological mobility of the implant is generated by the elasticity of the perimplant bone and by the thickness of the proteoglicanic layer between the implant and the bone. The rotation centre of an implant is next to the cortical bone from the top of the crest level, unlike the natural tooth which has the rotation centre at the junction point between the middle third and the apical third.

  Due to the fact that the forces are transmitted on a rigid field, they must be kept within certain limits not to overcome the resistance of the implant.

  When prolonged forces over the limit act on a natural tooth, this is summated to an intrusion which can be reversible. In the case of an implant the intrusion will not be reversible. It can manifest as:

  - Very slow physiological intrusion, but irreversible, maintaining the integration of the implant.
  - Nonphysiological intrusion, faster, which leads to the affecting of the implant bone integration to its mobilisation and its avulsion.

  Because there are no periodontal receptors, the capacity of perception and selection of the forces acting on the implants will be much diminished and it will be done on auxiliary ways, delaying the reactions in the central nervous system. There will be a delay in the perception of the premature contacts and/or of the interferences from the occlusal surfaces of the prosthetic works applied on the implants.

  In the case of the prosthetic works applied on the implants, the forces exerted at the occlusal surfaces must be equally and physiologically transmitted to all the implants which sustain the prosthetic work.

  The forces should be transmitted in the long axis of the implant because they create a compression effect over it. (picture no. 1)

  Picture no. 1. The compression effect over the axial forces (personal collection)

  ![Picture no. 1](image)

  The oblique or horizontal forces must be reduced or, if possible completely eliminated since they create a flexion and torsion action over the implant. (pictures no.2 and 3)

  Picture no. 2. The flexion effect under the oblique forces

  ![Picture no. 2](image)

  Picture no. 3. The torsion effect under the action of the horizontal forces (personal collection)

  ![Picture no. 3](image)

  The more the angle between the vertical axis and the direction of action of the forces increases, the
stronger the effects of flexion and torsion will be, even if the intensity of the forces is the same. (picture no. 4)

Picture no. 4. The more the angle between the vertical axis and of the direction of action of the forces increases, the stronger the effects of flexion and torsion will be. (Personal collection)

The morphology of the alveolar bone directly influences the resistance capacity of the implant to the solicitations. If occlusal forces are applied, the maximum solicitation at the bone border from the top of the crest. This is why this border should be as thick as possible. (picture no. 5)

Picture no. 5. The bone borders from the top of the crest should be thick to resist the action of the horizontal forces (personal collection)

When the forces do not go beyond the endurance level of the bone, they exert a positive action over it through regeneration and remodelation.

The transmission of physiological forces over the implants and the periimplant bone mainly depends on the topography of the implants and on the correctness of the prosthetic work confectioning.

The sum of the factors on which the force transmission over the implants depends is represented by:

- The elasticity of the periimplant bone
- The number, the dimension, the type and topography of the implants
- The number and dimension of the intermediates within the prosthetic restoration supported on implants
- The material out of which the prosthetic restoration is confectioned
- The static and dynamic occlusion

Particularities in the complete mandible edentation

In the case of the complete edentations, there can be applied various types of over-structures or there can be done a fixed prosthetic restoration supported on implants.

Concerning the over-prosthetics, there are 2 types:

- Stabilized on implants with mucosal support
- Stabilized on implants with mixed support (implant and mucosal)

The bow shape of the mandible in the anterior region is more favourable from the biomechanical point of view than the square shape. (pictures no. 6 and 7)

Picture no. 6. The bow shape of the mandible in the frontal region is more favourable (personal collection)

Picture no. 7. The square shape of the mandible in the frontal mandibular area is less favourable (personal collection)

The implants are connected to the bar only in the anterior mandible region since in the posterior region, the increased elasticity would be disturbed by this rigid structure and there would appear as an excessive solicitation of the implants.

In the fixed prosthetic restorations applied on the implants, the distribution of the forces obviously depends on the quality of the bone-acceptation too as well as on the degree of elasticity of the prosthetic work.

Choosing the way to restore the occlusion is done according to the presence of the missfunctions and to the nature of the opposite arcade.

- In the case of missfunctions in the history, a group guidance is preferred
- If the opposite arcade is represented by a complete mobile prosthesis, a balanced occlusion is done,
meaning an occlusion with contacts both on the working side and on the repose side during the mandible movements.

• If the opposite arcade is represented by the natural teeth, a mutual protected occlusion will be done, meaning an occlusion with strong posterior contacts in the maximum intercuspation and with canine or group guidance and inocclusion on the repose side during the lateral movements of the mandible.

• When the opposite arcade is completely restored with the help of the implants, the occlusal reconstruction is the hardest part to achieve because of the weak proprioceptive system of the implant-implant assembly.

In the implant-prosthetic oral rehabilitation it is essential to maintain the support prosthetic surface of the natural lost teeth. The support surface is very important in the physiological directioning of the mastication forces, thus reducing the failure rate caused by the over-the-limit forces applied on the implants.

CONCLUSIONS

Out of the methods to improve the support surface of the prosthetic works, there are mentioned:

• The insertion of a sufficient number of implants, correctly positioned and with a maximum diameter according to the existent bone offer.

• Achieving a balanced occlusion

• Extending the prosthetic works in the lateral areas of the arcades up to the mesial root of the second molar.

BIBLIOGRAPHY


