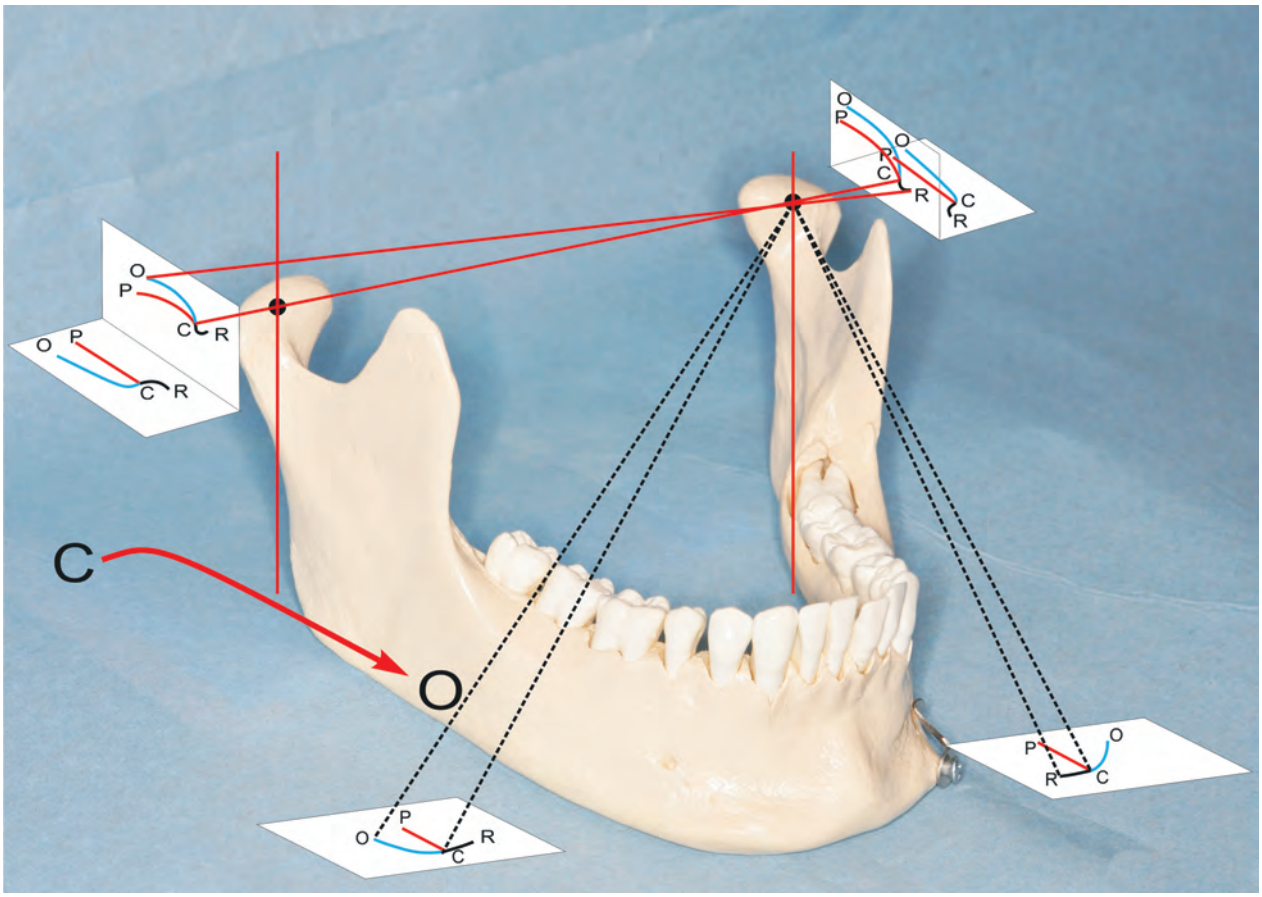
Piergiorgio Pasotti, MD DDS MSD

Learn dental occlusion



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Some drawings and images have been reproduced from Author's books[1,6] or authorized free of charge by the professor's family Frank V. Celenza[2], and others were conceived, and achieved personally by the Author.
The images are the documentation of clinical cases dealt with by the Author.
The laboratory steps were carried out by the Dental Technician Gino Marini and by the Dental Technician Giuseppe Piccinelli, to whom the Author gives special thanks for the dedication and competence they have shown because, without their work and their collaboration, it would not have been achieved the results set out and documented in this book.

Although only some of them are reported in this book, the Author thanks all the patients he has treated, because without their consent to be photographed, without their patience and collaboration, this book would never have been achieved.

Printed in Italy

With great esteem and affection I dedicate this book to the dental technician Gino Marini (1965-2021), sincere friend, trained collaborator, strenuous and tireless professional.

With great esteem, affection, and gratitude, I thank Prof. Frank V. Celenza for the results he has obtained with his research and for having disclosed them with his lessons.

In his courses and in personal conversations he transferred me his knowledge, without which I never would have achieved the results shown in this book.

«I have two criteria that guide my profession and I think, if you adopt these criteria, you will be able to achieve the maximum and obtain an excellent result.

The first criterion is that my work must be clinically feasible, and the second criterion is that it must be academically defensible[1].»

Frank V. Celenza
DDS MSD

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Presentation

The concepts set out in these pages are essential to perform correctly our profession. The book is addressed to both Dentists and Dental Technicians. In prosthetic treatments the two professions cannot be separated, they are complementary. Even Dental Technicians must have a thorough knowledge of dental occlusion. Dentist and Dental Technician must “speak the same language”. On the contrary, there will be no understanding between them, no fruitful collaboration and they will not achieve any result. So, even if their work is aimed at the health and good of the patient, there will only be a commercial relationship between them, aimed at presenting the footer account at the end of the month. To fully understand what is set out in these pages it is essential to pay attention to the words used. If a word is not identified in its real meaning or escapes, the concept will not be understood, it will not create interest and desire to continue reading.

The book should be read from the beginning without skipping any pages. What is expressed has a sequence and it is necessary to carry out the reading from the beginning. Each concept is preparatory to the following ones. Reading here and there, leafing through it, observing the figures and reading only the captions, the book will be incomprehensible. The concepts are very difficult, but they are explained in depth and motivation. The Dentist and the Dental Technician must carefully remember what they have read, link the concepts together and implement what they have learned from time to time. Only in this way they will be able to realize them in their work.

Someone objected that these concepts are only theoretical, that practice is something else. Instead it is not like that. Certainly these concepts are very difficult. But we must not reject what we do not know. Everything we don’t know is difficult.

This text was not achieve *to write a book or to appear*. At my age I have no protagonism’s aspiration, I have never had it, and I have no interest. I expose the concepts governing occlusion, and my purpose is to divulge the *indispensable knowledge* of the physiology of dental occlusion.

My ability and the results I have obtained, in over forty years of profession as a prosthodontist and gnathologist, of study and deepening study of the subject, allow me to proudly affirm that I have always given my patients the maximum knowledge scientific proposed.

Prof. Frank V. Celenza, my teacher and my professional guide since the beginning of my profession, said: «Never do anything that is not feasible. But above all, never do anything that is not academically defensible». And building dental prostheses by taking only a maxilla impression, a mandible impression, a mastication wax, the color and sending it all to the laboratory, is an academically indefensible procedure.

And the lack of knowledge of a part of his work does not justify the inability of

a professional. The dental occlusion is not a part of the dental profession. It is not a knowledge that can be done without. The occlusion have an enormous importance, it does not only affect the prosthesis, but it concerns and involves all dentistry. The occlusion is where all disciplines meet, it is the central part of dentistry.

This book does not have claim to be exhaustive. What expressed is only the introduction. However, I hope it creates curiosity, interest and desire to learn and deepen the topic. Knowing dental occlusion involves difficulty, commitment, and perseverance. It is essential to have the conviction that you need to know the Occlusion, which nobody talks about, which is not known by the vast majority of Dentists and Dental Technicians. But not their fault. In almost all Universities it is treated summarily, without attributing adequate importance to it. Therefore, if the Dentist and Dental Technician do not know the Occlusion, it is not their fault, but due to the lack of training of their school.

Occlusion is not learned in a short time. Rather it will be necessary to want to learn, to know, a lot of study, clinical application of what has been learned and experience acquired from the cases treated.

While studying these pages, do not be discouraged. I am sure that more you continue reading, more disinterested you will be. You will think: «What is the Author saying? These words are science fiction. I don't need to know these things. I have always carried out my profession seriously and correctly and believe that I am not a bad dentist. I don't need all this».

We have not choices. Do we want to give the patient what he asked us, even though he has not expressed it openly, and treat him for his good, as required by professional ethics or, if it goes wrong, are we insured? When there is a danger of life, the answer is obligated. We Dentists don't take things seriously enough; after that, the worst that can happen is that the patient will lose his teeth. In the dental field, when medical treatment is wrong, there is the belief that the error is acceptable or passable, of a small extent. But sometimes is not like this and the consequences can be very serious, even if there is no danger of life.

A lot is talked about temporomandibular dysfunctions. Courses on temporomandibular dysfunctions are organized. But the temporomandibular dysfunction is not a contagious infectious disease. The cause is always the wrong occlusion. We are the cause.

If we do not apply the rules and concepts of occlusion, the negative consequences will be many and will be irreparable.

Therefore I invite Dentists and Dental Technicians to draw their conclusions only at the end of the complete study of the book.

Piergiorgio Pasotti
MD DDS MSD

First part

Introduction

Knowing the occlusion is a fundamental commitment for the dentist. This knowledge is indispensable for him to be able to exercise correctly his profession. Occlusion has enormous importance, it does not only affect the prosthesis, but it concerns and involves all dentistry. It is a topic that is never talked about. Courses are set up that proudly show incredibles rehabilitations, but I have never heard any lecturer speak and even mention to the occlusion in the rehabilitations presented. Today we only talk about grafts of all kinds, of implants. At this point the dentist believe that to be considered a good dentist he must insert implants and graft tissue everywhere. Are inserted implants that arrive at the brain, without thinking about the occlusion. Dentists insert the implants, but then they have to be prosthetized, they do not worry about the occlusion of the teeth that are above the implants. And it is not enough to cover the implants with a crown. There are rules, which must be respected. If these rules are not observed, many injuries will arise, which can often be serious and sometimes incorrigible. Complete prostheses are built, on an entire arch, or on two arches at the same time, on implants or on natural teeth, with circular fixed prosthesis, or total mobile prosthesis on implants, but nobody worries about how the teeth, supported by those implants, they will articulate and be in contact with each other.

The way in which the teeth meet is called occlusion and the people who attribute to themselves the philosophy of measuring and recording the movement of the mandible, which essentially leads to the development of dental occlusion, were called Gnathologists. The structures that participate in the occlusion are the temporomandibular joint, the teeth, the muscles involved in the mastication, the nerves that control the muscles, the regulation and feedback systems, and the position of the head. Constructing the occlusion is not a logical, intuitive, obvious, banal, automatic action, or think that it is enough to put dental surfaces in contact, taking care to avoid that they get annoyed, that they do not touch before others. Learning and knowing the occlusion is very important. It is impossible to treat the occlusion in a few pages and even a some days will not be enough.

At the beginning of my profession, I always discussed with the technician, there was always some problem, the fusion was perfect, it fits perfectly, the prosthesis were beautiful, but the occlusion was always wrong. On the articulator it fits one way and in the mouth it fits another, and was always high. At that time I believed that I was the dentist and that the dental technician was the prosthodontist. I believed that I had the role of perfectly preparing the teeth, taking impeccable mastication and impressions to send to the dental technician; that it was then his duty to make the prosthesis in a precise and perfect way. I had always done my part correctly, but the jobs were always wrong and had to be corrected. So the responsibility was his. I did not know why these problems existed and I asked the dental technician why. He replied that he didn't know either. He said: «On the articulator it's fine, if it doesn't fits in the mouth, I don't know.» I think this happens to you too. And the cause was that I did not know the Occlusion. Then I learned the occlusion. I understand that the prosthodontist is the dentist. The dental technician is not the prosthodontist. The technician is a performer, who realizes what the dentist asks him and with the means that the dentist gives him. The dentist must know the occlusion and must provide the dental technician with the information and means he needs to create correct prosthesis. Only if will exists an agreement between the dentist and dental technician, nobody will have any more problems, and above all will not have the patient.

Have you wondered why fillings break, why ceramics splinter, why implants break or move, why total dentures move, why they create pain, huge and incredible injuries? It is always the fault of the wrong occlusion. We are the cause of these events, it is not a defect in the material or a mistake by the dental technician.

For some time there has been talking of temporomandibular dysfunctions, courses on temporomandibular dysfunctions are organized. But temporomandibular dysfunction is not a contagious infectious disease. The cause is always the wrong occlusion.

Legal liability

In disputes with the patient, if the dentist has made a mistake, the patient will be compensated by the insurance, because the insurance protects the professional from malpractice, imprudence, and negligence. But there is also a contractual liability. Then also the dentist will have to pay and will have to return what he has collected from the patient or even a higher amount established by the judge. So he will not only have worked for no pay, but he will have lost money and reputation. The dentist (Fig. 1) performed 25 implants in the maxilla and 18 in the mandible of that patient. Perhaps he thought that even if he lost some, surely there would be enough a number to support the prosthesis. The image speaks for itself and the dentist has been sentenced. But professional liability isn't just about cases like this.

Another dentist (Fig. 2) has been sentenced because he made a mistake in the occlusion. The insurance will pay 35 thousand euro in damages and 15 thousand euro in legal costs. To that money must be added those established by the judge that the dentist returned to the patient. It means that the OTC (Official Technical Commissioners) have begun to understand that there are also occlusal problems and write expert reports against dentists who have mistaken the occlusion. There were those in my courses who said that the concepts I have presented are only theoretical and that practice is another thing.

What I will tell you will help you learn how to practice correctly our profession. Obviously, it needs to know the rules that guide tooth contact. Now ask yourself if you want to be correct and treat the patient for his good, as required by professional ethics, or in the worst case, you are insured. When there is a danger to life, the answers are obligated. In the dental field, when the medical treatment is wrong, the error is considered of small entity, because at most the patient will lose a tooth or some teeth. But sometimes it doesn't. Usually, the dentist does not assign to the occlusion adequate importance. In conservative care, if a tooth touches before the others, the dentist believes that it is enough to touch up the contact and everything will be fine. In prosthetics he thinks that it is enough to mount the teeth in contact with the antagonists, he does not

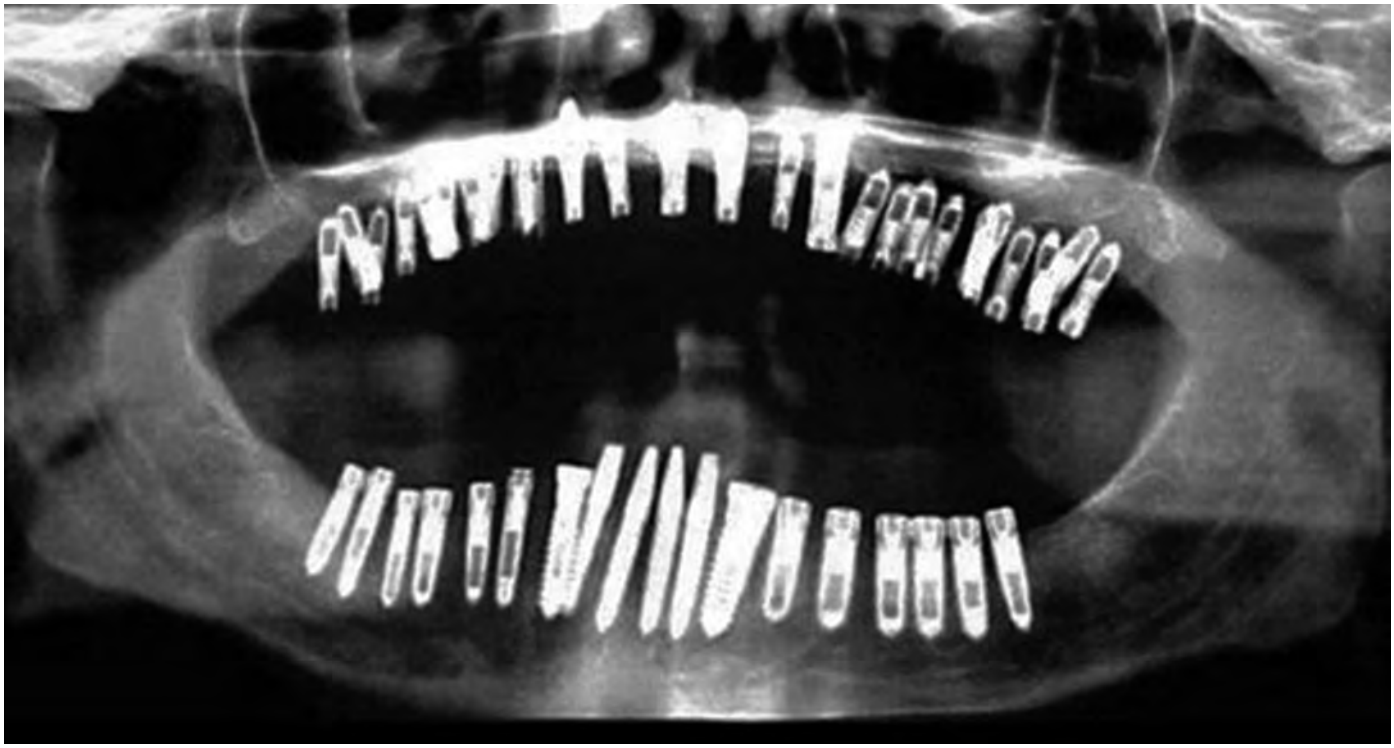

Fig. 1 The image shows a panoramic radiography of a mouth with 25 implants inserted in the maxilla and 18 in the mandible.

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Foglio 1

TRIBUNALE CIVILE

Dentista sbaglia le cure: deve risarcire quasi 50 mila euro

Non solo non optò per il trattamento che avrebbe potuto risolvere il problema della sua malocclusione dentale, ma le fece anche spendere un sacco di soldi per una protesi rivelatasi inutile. Ecco perchè, a distanza di dieci anni, il tribunale ha condannato il dentista [redacted], con studio in città, a risarcire a una sua ex paziente il danno causatole, per un totale di circa 35 mila euro, oltre alle spese di lite e legali, per quasi ulteriori 15 mila euro. Soldi di cui dovrà comunque farsi carico la Società [redacted] di assicurazione a sua volta chiamata in causa dal professionista. La sentenza è stata emessa dal giudice civile [redacted], che ha ritenuto fondata la domanda della paziente, rappresentata dall'avvocato [redacted], e, recepite le valutazioni del consulente tecnico, ha calcolato nel 2-3% il danno biologico permantente causatole. Alla donna, che all'epoca aveva 35 anni, è stata in particolare riconosciuta la liquidazione della somma necessaria per rifare 12 corone protesiche (11.400 euro) e i due rinnovi che, data l'età, dovrà affrontare.

La vicenda risale al 2006, quando la paziente si rivolse a lui per una malocclusione. [redacted] decise di trattarla limando tutti i denti dell'arcata superiore e inserendo una protesi fissa provvisoria. Il problema, tuttavia, non fu risolto e lei cessò di presentarsi. Da qui, le argomentazioni del difensore, avvocato [redacted] che ha attribuito la causa dei danni alla preesistenza di una situazione compromessa e all'interruzione delle cure. Entrambe ragioni respinte dal giudice. Il medico «accettò di svolgere l'incarico, conoscendo la situazione in cui versava – si legge in sentenza – e l'interruzione fu giustificata dal venir meno dell'imprescindibile rapporto di fiducia tra le parti». *(l.d.f.)*

Un dentista al lavoro
(A dentist at work)

TRANSLATION

CIVIL COURT

Dentist gets treatments wrong: he has to reimburse almost 50 thousand euros

Not only did he not opt for the treatment that could have solved the problem of his dental malocclusion, but he also made him spend a lot of money on a prosthesis that proved to be useless. This is why, ten years later, the court sentenced the dentist [redacted], with a studio in the city, to compensate one of his former patients for the damage caused to her, for a total of around 35,000 euros, in addition to the legal costs, for almost an additional 15 thousand euros. Money which will in any case have to be taken over by the [redacted] Society of Insurance in turn called into question by the professional. The sentence was issued by the civil judge [redacted], who considered the patient's request, represented by the lawyer [redacted], to be well founded and, having received the evaluations of the technical consultant, calculated the permanent biological damage caused to her at 2-3%. The woman, who was 35 at the time, was, in particular, recognized the liquidation of the sum necessary to redo 12 prosthetic crowns (11,400 euros) and the two renewals that she, given her age, will have to face.

The story dates back to 2006 when the patient turned to him for a malocclusion. [redacted] decided to treat it by filing all the teeth of the upper arch and inserting a temporary fixed prosthesis. The problem, however, was not resolved and she ceased showing up. Hence the arguments of the defender, lawyer [redacted] who attributed the cause of the damage to the pre-existence of a compromised situation and to the interruption of treatment. Both reasons were rejected by the judge. The doctor «accepted to carry out the task, knowing the situation in which he found himself - reads the sentence - and the interruption was justified by the failure of the essential relationship of trust between the parties».

(l.d.f)

Fig. 2 Italian newspaper article documenting the condemnation of a dentist for having mistaken the occlusion in the treatment of a his patient.

care how to mount them or how to build them. He delegates the project and execution to the dental technician. He takes an impression of the maxilla, an impression of the mandible, takes a mastication wax, establishes the color, and sends everything to the laboratory. He thinks his job is completed. The important thing is that the teeth are not high or too high to annoy the patient. The dentist does not worry about the occlusion, he is concerned with aesthetics, color, and smile. Certainly, these aspects are also important. But the occlusion has immense importance. The dentist uses a lot of articulation paper. The thinnest available to us is 40 microns thick. Forty microns is an enormous thickness for occlusion. And the dentist continues to touch up until the tooth is no longer in contact. He touches up all the colored surfaces, blue, red, green, or black. And he loses the occlusion.

In these pages, I will show the consequences of the loss of occlusion. You do not need to touch up all the surfaces in contact. There are rules: some surfaces must be retouched and others not, and must be left even if they are marked. Some dentists say: «It is not my problem. I inserted the implant and it is still in place, well fixed. The prosthesis is not my problem». But for the judge, whoever performs the implant is also responsible for the prosthesis although another colleague has built it and whoever performs the prosthesis is also responsible for the implant although another colleague has inserted it.

At the beginning of my profession, I met prof. Frank V. Celenza. I followed his courses and I understood why these problems existed, not between me and the technician, but between me and the prosthesis, between me and the performance I was performing. It was my luck. I learned and realized what he taught me and I immediately eliminated all the difficulties I encountered, not only in prosthesis but in all restorative treatments. Over the years I have followed many courses of him, and in my office, I have achieved what he taught me, and every day I verified more and more, that what he told me was true. I learned from his courses and when

I returned home I was able to put into practice what I had learned. I always asked him and noted how much he taught me. Initially, I wrote them for myself, as if they were notes to remember, to find easily and quickly. Then I realized that my difficulties and problems were common to all dentists. So I decided to report in a book[1] what I had learned from him. It is very didactic, it should not be browsed or read here and there, but studied carefully and thoroughly from the beginning. Each concept is preparatory to subsequent concepts. Those who have studied it told me that the existence of that book, now, will not grant any extenuating circumstances to the dentist who has mistaken the occlusion. If the occlusion is wrong, the dentist will not be defensible in the forensic field. For this reason, I showed the newspaper article with the condemnation of the dentist who had mistaken the occlusion. The topic of that text[1] and of this you are reading is unusual. Are organized only courses that make an audience. Occlusion is never mentioned, and occlusion courses are never thought of or organized. In courses and conferences, the speaker usually shows what he does and how good he is. Now I will not show you what I do, how good I am, but how good and capable you can be. The concepts presented in that book[1] and what is shown in these pages may be the most difficult you have encountered. The information I will give you will be new to you. Therefore it is very important that you pay attention to the words I will use. They have a very precise meaning, and if you miss a word you may not comprehend what I am saying. And even if you will be attentive, it is possible that you will struggle to understand, but do not be discouraged. The cause is that these concepts are very difficult, they have to be studied several times.

Initial concepts

Today in dentistry there are many controversies around the centric position and many people are confused about which is the correct centric position. The reason for this confusion is that whenever they hear some famous teachers or lecturers, they hear clinical explanations for what they do. If we could understand the physiology of the system, then the clinical application would be simple. A picture as we have it now is a new knowledge of physiology and by understanding this picture, then you will fully discover what is occlusion.

Now I am going to make three statements, which you probably don't understand now, but at the end of this book, I think you will understand.

First statement

I am often asked: «What is the ideal position for the joint when the teeth are in the maximum intercuspation position?» My answer is: «I don't know! And nobody knows». And most likely there is no ideal position. But from the physiological view, the centric relation is not that position. However, I use the centric relation.

Second statement

The precision of the position is more important than the position. The precision of the position refers to the stability of the occlusion. When I refer to the position, I mean the location, the localization of the joint. When I say that the position is not so important, I mean this: probably there is an area in the joint, which is acceptable, but this is not the long-centric; the long-centric refers to the level of the occlusion. Now I'm talking about an area in the joint. The concept of the long-centric has created in us great confusion.

Third statement

This is very much based on the physiology.

The function of the temporomandibular joints is not to load the teeth, rather it is a function of the teeth that unloads the joints. On this basis, the teeth can be considered sensory end organs, directly correlated with the central nervous system.

As professionals, we are interested in our dental restoration and how we can minimize the occlusal adjustments. What do we prefer? Complete everything directly in the patient or indirectly in the laboratory? Is this what we prefer? Or perhaps, what we prefer, more adjustments indirectly out of the mouth and less or many few done directly in the mouth? This is reality. When I speak of the physiology of the system, I speak of

occlusal management. If we do not understand the physiology, then we cannot understand the occlusion. Occlusion is where all disciplines meet. Occlusion is the central part of dentistry. We are talking about occlusion management and how we can coordinate it with the physiology of the system. So we must be addressed the centric position and the first position we need to pay attention to is the centric occlusion position. Centric occlusion is the position of maximum intercuspation, with no reference to joint position.

We dentists think in terms of changing the centric position, while instead we should think in terms of preserving, of maintaining the centric position. When the teeth are in the position of maximum intercuspation, the joints are in a suspended position. This is a normal condition. On one side the condyle is further away from the rear wall than on the other side (Fig. 3). And on one side it is even further away from the roof of the fossa than on the other side (Fig. 4). And it is also further away from the medial wall (Fig. 4) than from the other side: it is in a three-dimensional suspended position and it is asymmetrical.

The joints of the body can be distinct into two categories:

– weight-bearing joints
– non-weight-bearing joints

A weight-bearing joint is a joint that articulates on a border path, in the normal position. If we consider that the normal position is standing, then the hip joint and knee joint are weight-bearing joints. And if the standing position is the normal position, then the shoulder joint and the elbow joints are non-weight-bearing joints. So the weight-bearing joints have an infra-marginal, infra-articular space, minimum.

Non-weight-bearing joints have a larger intra-border space. Weight-bearing joints become non-weight-bearing joints during rest. For example, when I sleep, the hip and knee joints are non-weight-bearing joints at that moment. Non-weight-bearing joints can become weight-bearing joints when the function is demanded. For example, if I lift a suitcase, the shoulder joint becomes a weight-bearing joint. There is another characteristic of the joints and this is the distraction. Some joints can be stretched, and stretching increases the infra-border space, infra-articular space, beyond the physiological dimension. When is lift a heavy suitcase, the shoulder joint becomes a weight-bearing joint and the elbow joint becomes stretched.

So the questions we must answer are these:

– Is the temporomandibular joint a weight-bearing joint or is it a non-weight-bearing joint?
– And is this capable of being stretched?
– If it is a weight-bearing joint, then in a normal posture, should it articulate on a border path?
– If it is a non-weight-bearing joint, then in a normal posture should it have an infra-border space?
– But with certain particular functions, can it articulate on a border path?
– If the teeth are in contact at that time, should be in contact all the teeth or just some tooth

Fig. 3 On one side, the condyle is farther from the rear wall than on the other side.

Fig. 4 On one side, the condyle is further away from both the upper wall and the medial wall than the other side.

surfaces?

These are the questions we have to answer because the answer depends on where we place the occlusion.

When Gnathologists, in the beginning, began to study the occlusion, and they were the first to really studied it, was their opinion that the occlusion was constructed incorrectly and that the maximum intercuspation should coincide with the centric relation. McCollum, the father of gnathology, established that when this condition does not exist, patients suffer from periodontal disease. We now understand that this is not true. So now we have to use the scientific knowledge we have available today and formulate a physiological basis for occlusion.

In those pictures, I showed you the normal condition. When the teeth are in maximum intercuspation, the temporomandibular joints do not articulate in a limit position. So this is the correct position. And on this basis, the temporomandibular joint is not a weight-bearing joint.

Centric relation

The protrusive, of right and left laterality movements, on the horizontal plane, draw a Gothic arch as in that figure (Fig. 5). The centric relation is position 1 of the picture, and the centric occlusion is position 2. The centric occlusion is within the path, in front of the centric relation, and does not lie on the straight protrusive path, but it is shifted (it can be to the left or right). This means that the centric occlusion is not a limit position. This happens because the temporomandibular joint is in a suspended position. This means that when mounting models on an articulator if you are using a centric occlusion system, you must not use a centric relation articulator, because a centric relation articulator refers to the joints in the limit position. They are two completely different systems. The centric occlusion system and the centric relation system.

For now, I will talk about centric occlusion as normal condition, while the centric relation is a treatment system. And this is a very important point to remember. The centric relation refers to the joints when these articulate on a border path. Since the temporomandibular joints can operate on a border path, we can use the articulators, we can take protrusive recordings and laterality recordings. But all these informations are valid only when the joints are in a limit position. And it is at this stage that we can use the articulators. When the joints have an infra-border space, in other words, when they are suspended by the occlusion of the teeth, the articulators are of no value. It is a different system. Do not mix the two systems. This is the great confusion in dentistry today.

Most of the time I go to a laboratory, I see technicians building bridges, on a Whip Mix® articulator or a Denar® articulator. This is incorrect, this is wrong. Those are articulators of centric relation. You cannot use an eccentric movement on an articulator unless the information has already been given to the articulator. If you use an average path, it may very well be a path that the patient never uses. And if you are adjusting your restoration to an average path on an articulator, you may be abrading some teeth surfaces that the dentist might use when adjusting directly in the patient.

If we have a tooth modeled in that way (Fig. 6), seen from the buccal surface, the technician models the groove in the position of the arrow when he closes the articulator in the centric position. So he moves the articulator in a lateral excursion; the articulator dictates the position of the left arrow for the groove (Fig. 7). He must then bring the fossa and the groove further back and remove all the dotted part (Fig. 8). Let's go now into the patient. The patient wants the

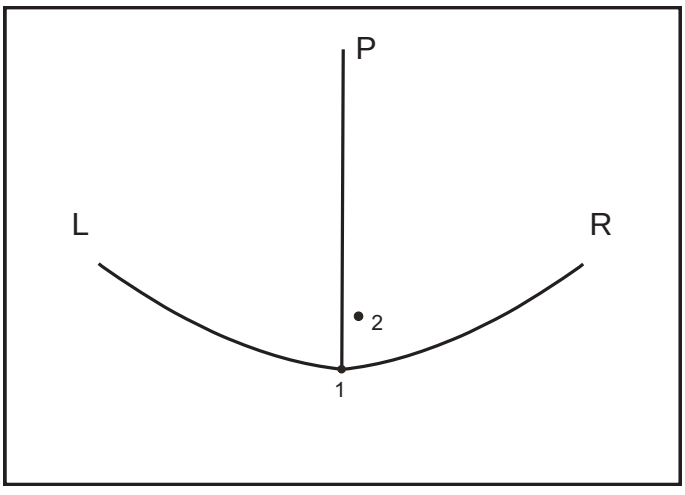

Fig. 5 The protrusive, right and left lateral movements on the horizontal plane draw a Gothic arch as in this figure. The centric relation is position 1 of the picture, the centric occlusion is position 2. The centric occlusion is within the tracing, therefore it is not located on the limit of movement, and does not lie on the straight protrusive path, but it is displaced (can be to right or to left).

groove more mesial, in the position of the arrow on the right (Fig. 9). Then the dentist removes the whole mesial part, the dotted part on the right (Fig. 10). And so, now we have a long-centric. And if I have modeled in that way I must say, I believe in the long-centric. But the long-centric is not a physiological reality, it is an excuse for inaccurate dentistry.

Many dentists think to minimize errors and make the prosthesis tolerable to the patient using average values. But what are the average values? Remember that the average takes information from the left and the right. And you have no idea on which side, or position, the patient is. It is conceivable that no patient is in the middle, but all averages are in the middle. So if the articulator that you are using has not been programmed to move like the patient, do not move it. It is best for you to perform all corrections in the patient's mouth. The technician can only put in the articulator the information that has been given to him. Why is this important? Let's think about what we are doing now. How do you build a crown? You prepare the tooth, you take an

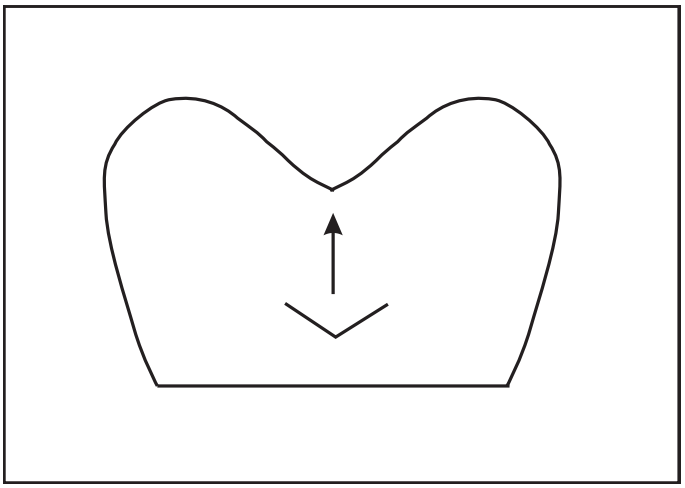

Fig. 6 If we have a tooth modeled in this way, seen from the buccal surface. The technician shapes the groove in the position of the arrow.

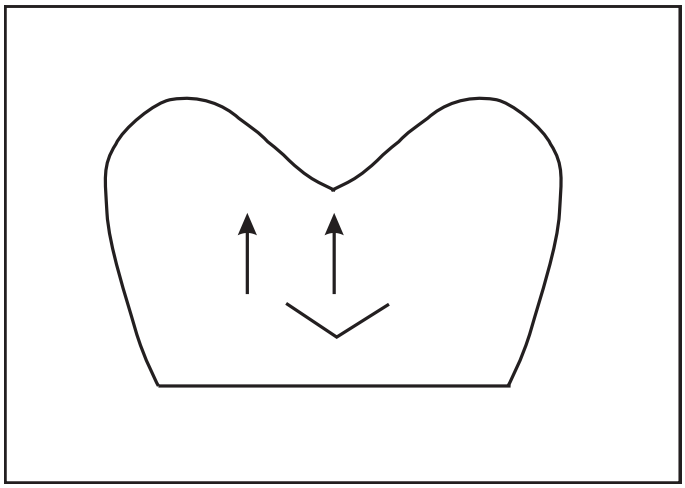

Fig. 7 The articulator dictates the position indicated by the arrow on the left for the groove.

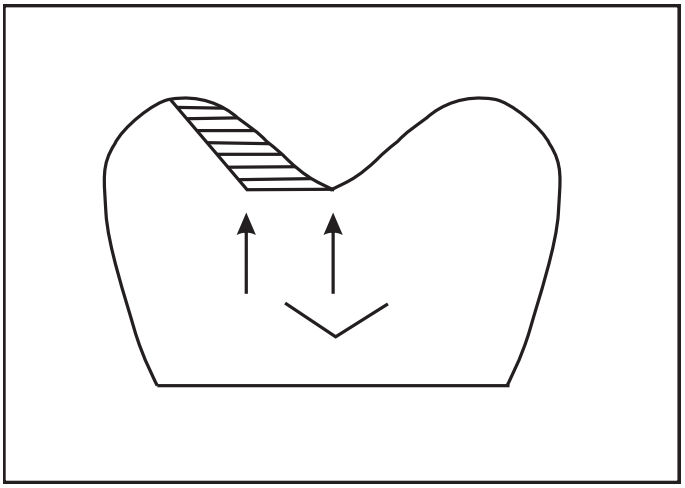

Fig. 8 The articulator dictates the position indicated by the arrow on the left for the groove. Then the technician must then bring the fossa and the furrow further back and remove all the dotted part.

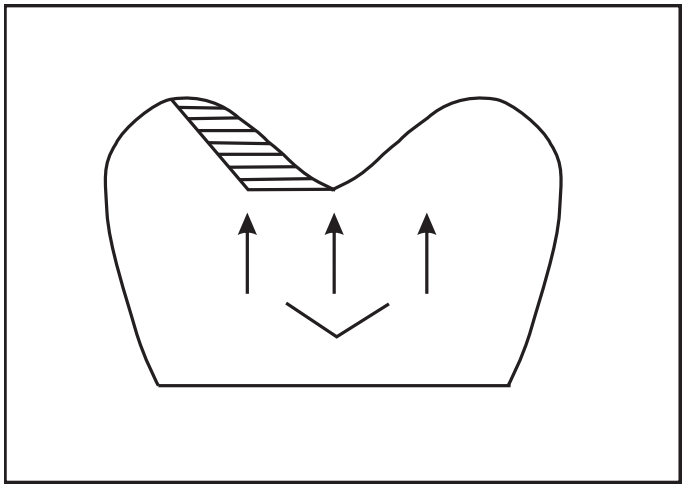

Fig. 9 The patient wants the groove most mesial, in the position of the arrow on the right.

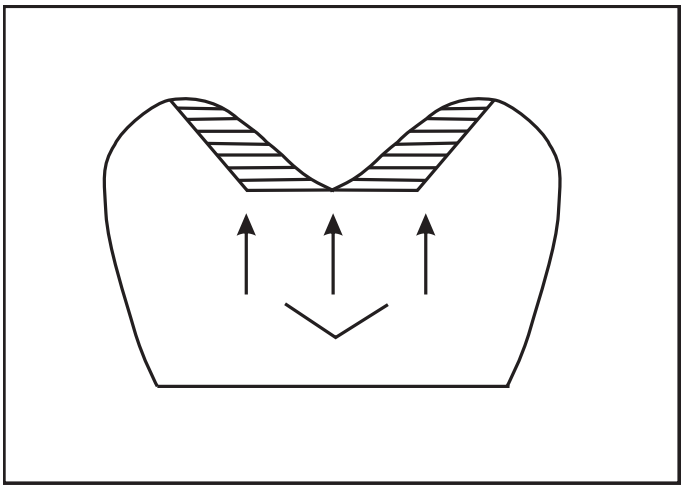

Fig. 10 The patient wants the most mesial groove indicated by the arrow on the right. Then the dentist removes the entire mesial part.

impression, you take a wax between the teeth, cast a model, and you send everything to the technician. What information does the technician have? Only one position: only the centric position with the wax, is all he has. Then he mounts it on an articulator and begins to model a beautiful crown. It puts cusps, fossas, developmental grooves, marginal ridges, supplemental grooves and then polishes it and makes it beautiful. And while he is building it, he moves the articulator, because he thinks helping the dentist. Then the doctor places the crown in the patient's mouth and asks to the patient close it. And the patient says he can't get his teeth together, because the crown is tall. So what does he do? He takes an articulation paper and puts it between the teeth and sees where it marks. Then he takes a big wheel and begins to scratch all the cusps, all the grooves, all the ridges, and all the fossas until the crown becomes lower, always lower. And finally, the patient says: «Wonderful! So yes that's fine. I don't even feel it». And that is because it is too low. This is how many build a crown. Each of you until yesterday made a crown just like that. Tell me what you think happens to the centric position, if you build that crown or that filling on the first premolar, and then on the second premolar, and then on the first molar, and then again on the second molar? What happens to the infra-border space? The joint tilts lower on that side. But, because the patient can adapt, we usually get by like this. But sometimes not. And prof. Celenza says: «And I don't know if you see this in Italy too, but in America we see it. We have an epidemic of temporomandibular joint dysfunctions and all of a sudden, dentists we had never heard of before, and most of them don't even know how to build a crown, they become experts on the temporomandibular joint. And this is a very dangerous area because I guarantee you that there is nobody around who knows more about the temporomandibular joint than I know and I tell you that I don't know anything. So be careful: there are a lot of charlatans who pass off to be experts».

With the centric relation, you can use a face bow, you can take a record of the centric relation, and you can take the information of the eccentric positions. Since the joint is located on a border path, marginal, you can use an articulator for the centric relation. You can take registration of the centric relation at an increased vertical dimension and move the articulator to arrive at the centric relation. But with centric occlusion, you have to register at the three-dimensional positions. In centric occlusion, you cannot have a path to get to centric occlusion. In centric occlusion you must record the precise position, you cannot move away from it, because there is no recordable path to approach the centric occlusion. And the reason is because the joint is suspended and it is not in a position, on a path, limit. So there are advantages in the centric relation, but it is not a normal physiological position. This is a very important concept, which must be understood and remembered.

Maintain centric occlusion

We dentists must think in terms to maintain centric occlusion and the reason why it is so important to maintain centric occlusion is that once we have lost it we cannot recover it. Once we have lost the infra-border space, we cannot longer recover it. The reason we can't get recover it is because we don't understand how to extend, distract, or stretch that joint. We don't know how much to distract that joint, and we can't duplicate the asymmetrical distraction that was there before. You see, the joint is in a suspended position, the teeth prevent, impede the joint from reaching its limit position. The normal condition is that when a patient has a centric occlusion he also has a centric relation. The centric relation is normality, but the teeth do not come in contact all together in the centric relation. The teeth come in contact all together in centric occlusion. When we make both coincide, the centric occlusion with the centric relation, then we create an occlusion in centric relation. This is an abnormal position of the physiological stop point, it is a prosthetic invention. We have created this. Perhaps before learning how to build in the centric relation position, we must probably first learn how to maintain centric occlusion, because if we learn how to maintain centric occlusion, probably there is no need for an occlusion in centric relation.

Let's imagine a Denar® articulator, seen

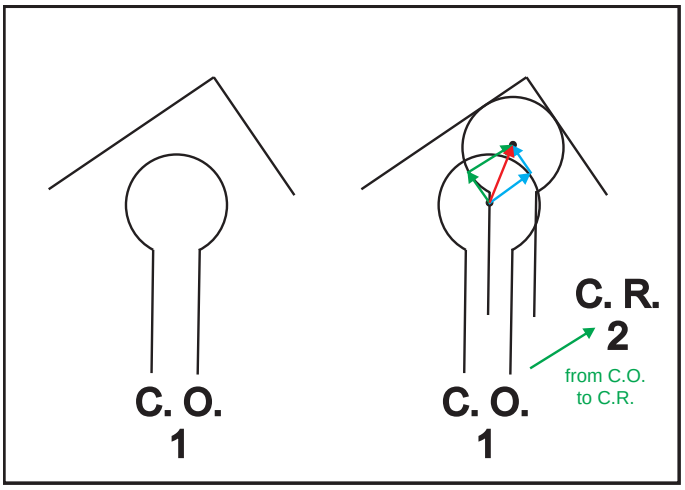

Fig. 11 There is no recordable path to go from position 1, of centric occlusion (C.O.), to position 2, of centric relation (C.R.).

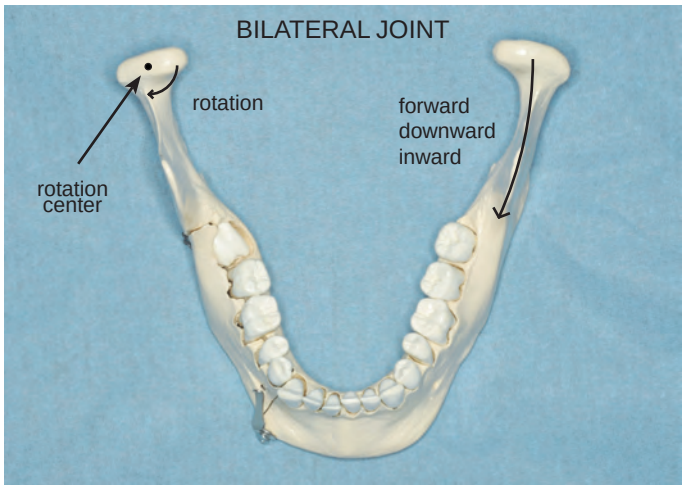

Fig. 12 The temporomandibular joint is a bilateral joint. The arc drawn on the left condyle is a pure circle arc with center exactly in the center of the right condyle, as for the right condyle.

from the sagittal plane (Fig. 11). Let's look at the sphere of the articulator and at this moment position 1 is the patient's centric occlusion because the teeth are in contact all together, articulate in that position and the joint is suspended. Position 2 is the centric relation, in the limit position. How do we move from position 1 to position 2: do we move back and then up on the blue track, or up and then back on the green track, or straight diagonally on the red track, or anywhere in between? We do not know the layout, the path, and there is no relationship to the route; and if the patient has his head bent back, he will follow a path; if he instead has his head bowed forward, he will follow another; or if he has his head tilted to the right or the left, he will follow another path again. So how do we incorporate information on occlusal surfaces if we don't know which way to go? And even if we knew how to get there, how would we be able to model all the sides, all the cusps to agree on the path taken to get the condyle up there? There is no way to do it. This is where a big mistake has been made by those who support the long-centric. They had tried to incorporate the two positions as if they were interconnected, and instead, there is no connection. They are two completely different systems.

The temporomandibular joint is a bilateral joint (Fig. 12). There is a movement on one side that is limited and which will also be coordinated by the movement on the other side. If the rotation occurs, for example, on the patient's right side, what kind of movement will occur on the other side? It is a forward, downward, and inward movement. What movement do you think is on the left side? Someone says this is a translation movement. This is a unique bone. If the right side is rotating, the left side is also rotating. The only way it could be translation is if there was a fracture. What makes us think that it is translation to the left of the patient is that the arch is wider on the side farthest from the center of rotation. But this is because the center of rotation is on the right side. And closer you are to the center of rotation, the smaller the circle will be. Because smaller is the radius, the smaller is the circle and longer is the radius and larger is the circle.

Physiological factors between dental contacts and temporomandibular joint

Let's now look at the five physiological factors that link dental contacts and the temporomandibular joint. Let's talk about the contact relationships between the teeth.

1. In a normal occlusion in the temporomandibular joint, there will always be an infra border space.

It means that in maximum intercuspation, in protrusive head to head, in right and left laterality there will always be an infra border space in a normal occlusion. When the joints are manipulated until the contact of centric relation, then there is a housing of the fulcrum in the joint and no space infra limit. But this is an abnormal position that is achieved with manipulation.

2. During a forced closure, a tightening, could be shown that the maximum contraction force occurs in the position of maximum intercuspation.

This is achieved with two surface electrodes that are placed on the masseter and on the temporal and the patient, on command, forcefully brings all the teeth together, in maximum intercuspation, in protrusive, in right and left laterality and even in a guided position of centric relation. It can be shown that the maximum force, in accordance with the muscular response, is exerted in maximum intercuspation. In other words, there is the maximum activity, maximum force in the position of maximum intercuspation rather than in the other positions, protrusive or lateral right or left, when the patient is asked to clamp. This does not happen during the function, but only by asking the patient to tighten.

3. During normal mastication, the maximum force of the masseter and temporal muscles happens in a position immediately before dental contacts.

This happens during normal mastication, which is different from intentional, forced, closure. Let's talk about the peak of the force. The teeth increase their force during mastication, until this reaches a peak, a maximum value. It means that during the mastication function, as one approaches the contact of the teeth the force begins to decrease. This is a very interesting fact from a physiological point of view. Because? What is this reporting? It would be easier to understand if the force decreased after the contact between the teeth. If the force decreases first, what does this tell you? I'll talk about it again.

4. During normal mastication, also the maximum acceleration of the masseter and temporal muscles occurs in a position immediately before the teeth come into contact.

So we have both force and speed decreasing as we get closer to the point of contact. You can see that it seems that it is the intent of the physiology of the system to protect the teeth, that is, to impede there is load on the teeth. It is therefore thought that there is another mechanism, that there is a center for the regulation of mastication. They now call it "path term generator". This path term generator center appears to regulate this mechanism so that the teeth are not overloaded.

Points three and four show that there are neurological protective mechanisms, which protect us from overloads on the teeth.

The second point shows that with a command closure, we can exert maximum force and maximum muscle activity at the level of the teeth in contact. Which means we can climb over the protection mechanism. On these bases, I think these neurological protective mechanisms are like neurological advice, but we can climb over them and we do this when we clench our teeth and when we brux.

These parafunctions are destructive and since the clenching is purely isometric, it is more destructive than bruxism. Because with bruxism there is movement, change in length, and in this way, there is a certain dissipation of forces; while with the clenching there is no decrease in length, there is no dissipation of forces.

5. During normal mastication, the first dental contacts occur on the non-working side.

This is a very interesting observation, because it has been tested on patients who could not have dental contact on that side without a bolus. Then the question arises: "How were they able to do it with the bolus in their mouth?" With the bolus, suppose on the right side (Fig. 13), during the final phase of mastication, the first contact will be on the left side. What has to happen is that the mandible somehow rotates using the bolus as a fulcrum. So the contact takes place on the non-working side. So that to happen, there must be a sagittal rotation of the mandible. In that way the internal side of the palatal cusp of the upper teeth must exert contact with the internal side of the buccal cusp of the lower teeth (Fig. 13). What happens is that there will be a successive series of rotations, un-

til the maximum intercuspation is reached: contact on the bolus, which becomes the fulcrum, then rotation of the mandible with contact on the non-working side, which becomes the fulcrum, and then rotation of the mandible towards the bolus, and a little more is entered into the bolus, which becomes fulcrum, and then there is contact again on the non-working side, until the teeth enter more and more into the maximum intercuspation. When this is reached, all the receptors of the periodontal ligament are recruited and exert their inhibitory action on the muscles, which have already begun to decrease in force and speed, as mentioned in points three and four, and finally the entire system is discharged. The mandible opens and is ready for the second cycle. So that last point can occur, which is the key to everything else, there must be an infra border space, otherwise one cannot have that sagittal rotation. This indicates that the temporomandibular joints are not weight-bearing joints and should lead you to wonder how different the function would be if you had reconstructed the patient's dentition, in a centric relation system, in which you removed the infra border space.

What we have described is the normal function. There is a series of sagittal rotations during normal mastication, where the fulcrum alternately passes from the bolus to the first dental contact on the non-working side. As this rotation alternates, first on one side and then on the other, the teeth come closer and closer to maximum intercuspation. Finally, maximum intercuspation is achieved, and just before contact, the bolus is swallowed. When maximum intercuspation is reached with a contact of all teeth, this contact supports the unloading cycle and subsequently, the mandible opens and is ready for a new cycle. So the first tooth surface that touches, during mastication, is on the non-working side.

In reality, the contact of the teeth on the non-working side prevents the joint from coming into contact (Fig. 14). So that this last point occurs, which is the key to everything else, there must be an infra border space, otherwise this sagittal rotation cannot be achieved. This is normal. When we create an occlusion in a centric relation system, we obliterate the inter-articular space, the occlusion becomes more critical, and it is possible that we construct the occlusion not coinciding with the joints. So if the patient closes on the bolus, it is possible that there is a contact in the joint before that between the teeth (Fig. 15) and this is pathological, it is a temporomandib-

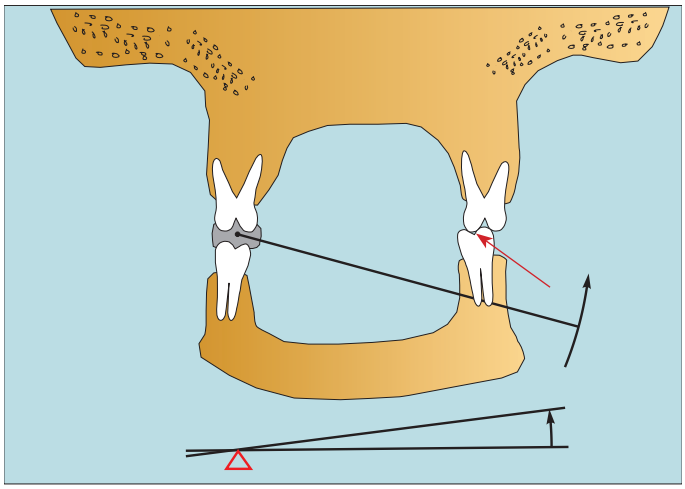

Fig. 13 During mastication, the mandible performs a sagittal rotation around the fulcrum located in the bolus on the right (working side) and the first contact is on the non-working side (red arrow on the left).

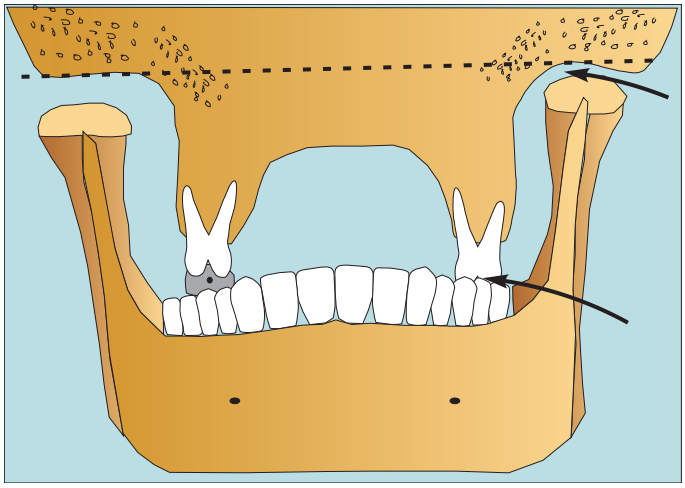

Fig. 14 During sagittal rotation, the contact of the teeth on the non-working side (left) prevents the joint from reaching its limit.

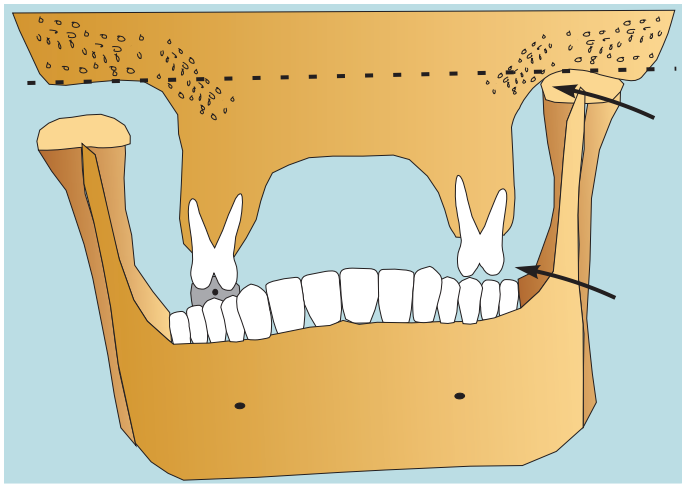

Fig. 15 If we obliterate the inter-articular space, there may be contact (on the left) at the level of the joint before contact between the teeth on the left side.

ular dysfunction because the temporomandibular joint becomes a weight-bearing joint. And the temporomandibular joint is not weight-bearing. Perhaps before learning about temporomandibular dysfunction we should learn how to avoid temporomandibular dysfunction.

The fundamental concept on which occlusion is based is stability. The mandible closes in the position established by the teeth (see Posselt's path page 137). And when it closes it must remain immovable, fixed, in that position, which is unique. The position of maximum intercuspation is the most closed position of the mandible. When the teeth move from that position, they will move away and the mandible will open, taking on a more open position. The teeth will move away from each other. The teeth should not lean against randomly in different positions from each other. The position of maximum intercuspation is and must be unique. So the end position of maximum intercuspation must be in a fixed, precise, stable point, not in an area (see Posselt's path page 137). We are rehabilitating teeth lesions, of a tooth, or of some teeth, by means of a prosthesis or in simpler cases even just with a filling. And our purpose is stability.

The teeth stop the closure and determine the final position of the joint (Fig. 16). When that position exceeds the physiological width of that extremity then we will find ourselves in trouble.

We imagine that the patient has a normal occlusion and is moving forward in a straight protrusive motion (Fig. 17, Fig. 235 and text page 137 Chapter 8). In that movement, the anterior teeth will always be in contact with each other until they reach the head-to-head position. Usually, during this movement, the posterior teeth will distance. If the patient continues in the protrusive movement, he will lose contact between the anterior teeth and acquire contact with other immediately more posterior teeth. If he can continue further, the protrusive will lose contact between those more posterior teeth and will acquire contact on other even more posterior teeth, until reaching the maximum protrusive position.

The same event happens in left and right lateral movement. So in the tooth contact position, keeping the teeth in contact, in whatever position or movement we are in, the teeth will

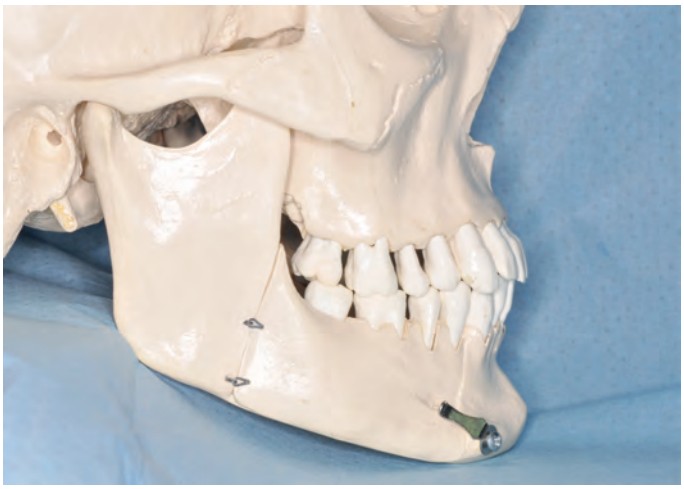

Fig. 16 The teeth stop the closure and determine the final position of the joint.

determine the final position of the joint. I am not referring to the final closing position, but to the position support of the joint depending on the teeth's position at that moment.

Therefore the teeth stop the closure at any moment and determine the final position of the joint. If the teeth are not in contact, the mouth is open, there is no contact between them, and the mandible, at that moment, does not perform any work and is therefore not subjected to any load.

When the patient loses his teeth, all or only some on one side, during a mastication movement there will be no teeth on that side that

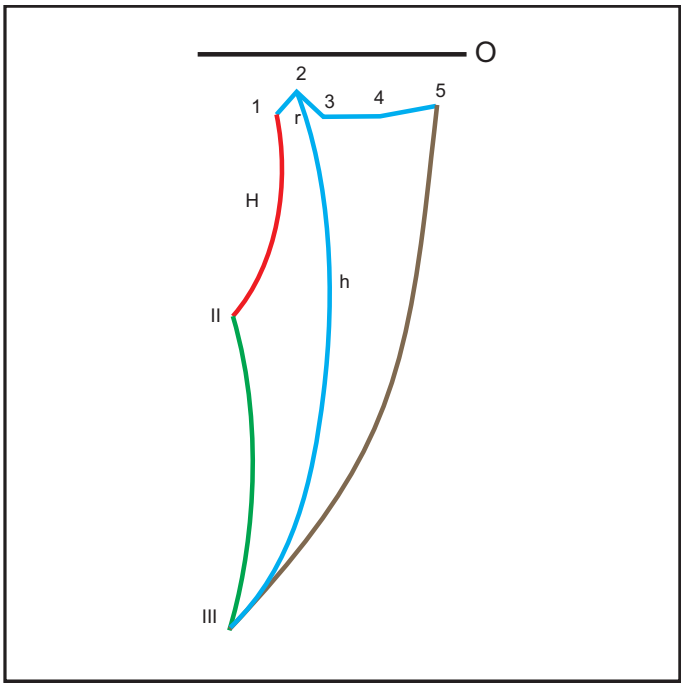

Fig. 17 Posselt's track. The number 1 indicates the position of centric relation; number 2 the centric occlusion (maximum intercuspation); the number 3 the protrusive position with anterior teeth in head to head; numbers 4 and 5 show the most advanced protrusive position until the maximum protrusion (5) (detailed explanation on page 137 Chapter 8).

will protect the temporomandibular joint. Then the joint can be loaded and a temporomandibular dysfunction will be created. If this situation continues for some time, not necessarily for a long time, the dysfunction may worsen and become incorrigible.

The likelihood of this happening will be greater and more serious if the teeth lost will be numerous. If the loss will be of one or two teeth, less serious if they are not contiguous and if are

Fig. 18 Shim stock is 8 µ thick and 8 mm wide. It is preferable to use this because it is held by only one tooth and its thinner thickness gives greater precision.

Fig. 19 Shim stock is 12 µ thick and 16 mm wide. Is preferable use the 8 mm wide one, because this 16 mm can be wider than the tooth and simultaneously affect two teeth and falsify the test.

Fig. 20 Crown cemented in the mouth (view in the mirror).

Fig. 22 Crown cemented in the mouth. Control with the shim stock: it is held between the 25 and 26 and 35, teeth not restored.

Fig. 21 Crown cemented in the mouth. Control with the shim stock: it is held between the 26 and 27, unrestored teeth, and 36, restored tooth.

Fig. 23 Crown cemented in the mouth. Control with the shim stock: it is held between the 26 and 27, not restored, 36, restored, and 37, not restored.

not on the same side, it is possible that, in protrusive or lateral right or left movements, other teeth protect the joint. If the lost teeth are some teeth and they are on the same side or are missing on the whole side, the consequences will be more serious.

That strip is called shim stock (Fig. 18). Do you know it? It's a spacer, a feeler gauge. With that, I can know the space existing between two structures that come into contact with each other. I insert that strip between the two structures. If the space between the two structures is less than the thickness of that strip it will remain trapped between them. If the gap is greater than its thickness, the strip will not be held and will be able to exit from them. It is used in dentistry to know if two teeth are in contact or if they are not. That strip has a thickness of 8 microns and a width of 8 mm. It exists of those sizes but it exists also 12 microns thick and 12 mm wide (Fig. 19). I prefer to use the one that is narrower than 8 mm because it is held only under one tooth and its antagonist. Instead, the larger one can remain under two contiguous teeth of the same arch, and falsify the test. Furthermore, the narrower one is thinner and in this case, the test is more precise. When we perform a crown or any other reconstruction, we must verify that the occlusion of that treatment is correct. The reconstructed tooth, with a filling, with a crown, or with any other prosthetic treatment, fixed, mobile, combined fixed-mobile, or with a total prosthesis, must be checked if it comes into contact with the other teeth, if it is high (that's what you're usually looking for) or if he's out of contact. This thickness gauge allows you to check the conditions I mentioned with a tolerance of 8 microns.

Let's look at a finished and cemented crown in the mouth (Fig. 20). We must check that it is in contact with its antagonist in the same way as the other teeth: it must not be high, it must not be out of contact and it must come into contact with the other teeth, with the same precision, the same tolerance and with the same load. We see that the shim stock in a normal closure is held between the restored tooth, 36, and its antagonist (Fig. 21). But it is also held between the tooth that has not been restored, 37, and its antagonist, 27, and between 35 and 25, teeth that have not been touched (Fig. 22-23). Therefore the occlusion is identical on all teeth, on the restoration, and the unprepared teeth with a tolerance of 8 microns.

I also perform this check when I reconstruct a tooth with a filling. Check that the shim stock is held on the restored tooth, on the tooth before and the tooth after. But I check that it is also retained by the teeth on the other side. This maneuver gives me the certainty that I have not made any mistakes. If the shim stock slips away and comes out of the tooth treated with a crown or with a filling, it means that the occlusion I created is short and that the tooth is out of contact. And so I made a mistake, I lost the occlusion. If the shim stock is held by the restoration but will slide off the tooth before and the tooth after, the reconstructed tooth is high. Then I will have to correct it until the shim stock is retained by the treated tooth, by the tooth before and by the tooth after restoration, and also by the teeth on the other side.

Levers

Joints are levers' systems. Physics teaches that there are three lever classes (Fig. 24). We have a lever with the fulcrum that lies between force and resistance: this is the first-class lever. This is the most powerful and efficient lever. These are engineering definitions, non-biological. But you have to understand what are the parameters with which an engineer thinks in terms of efficiency. When an engineer thinks in terms of efficiency, he considers the amount of force F, which is exerted at one end of the lever, and

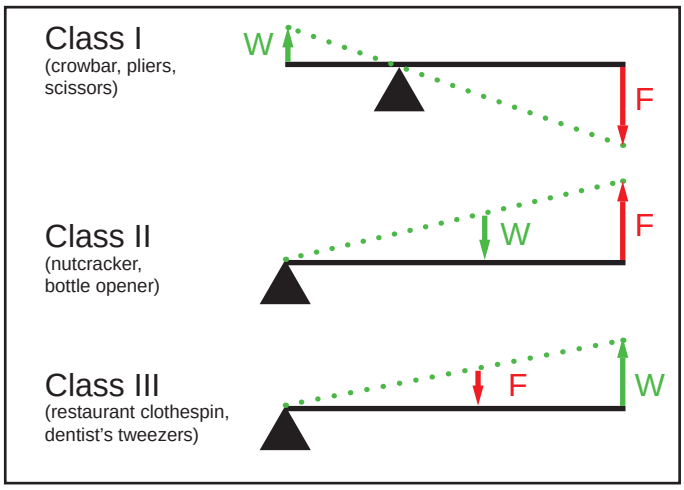

Fig. 24 Levers classes: inter fixed (I), inter resistant (II), inter powerful (III). F denotes the force, W denotes the work or resistance, and the symbol ▲ is the fulcrum.

if there is no appreciable loss of energy at the end of the resistance, he considers this an efficient lever. The other lever, second in efficiency, is the second class lever. It is the lever in which the fulcrum is at one end, and the force at the other end, and the resistance is in the middle. The least efficient is the third-class lever, in which force lies between the fulcrum and resistance. To more easily remember the type of lever we call the first class lever inter-fixed, the second class inter-resistant, and the third-class inter-powerful. When looking at the skull in the sagittal plane (Fig. 25), in this plane we see that the relationship between bolus and force is a third-class lever. There is an interesting feature of this lever: while on the one hand, it is the least efficient, on the other it is the fastest, so you gain in speed and lose in efficiency. But there is a feature that protects this lever because the further away from the fulcrum the work is, the less reciprocal force will be, the force developed. This is a protective mechanism.

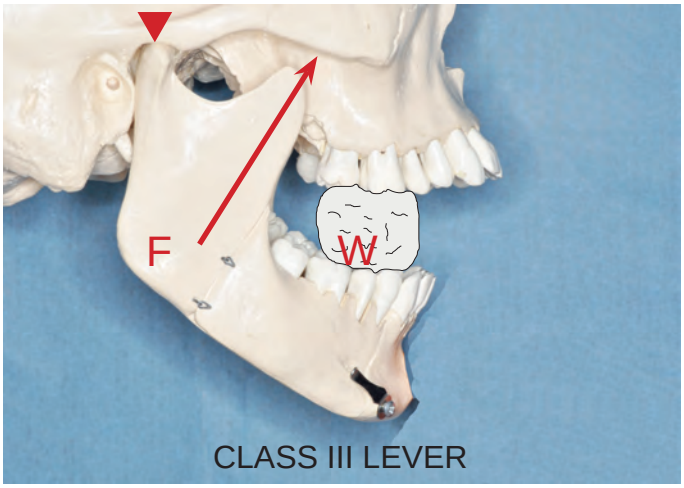

Fig. 25 Sagittal view of the cranium: class III lever. The fulcrum is in the joint and the work is in the bolus.

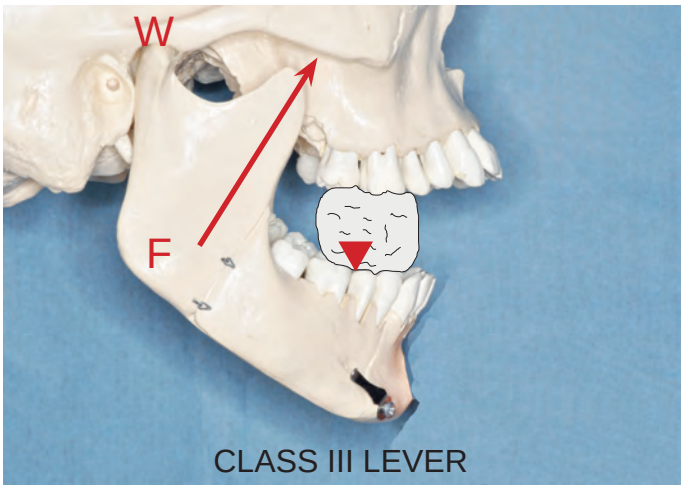

Fig. 26 If the bolus is resistant, for example, a kernel, it happens that the fulcrum is transferred. It is still a class III lever, but the fulcrum is transferred to the bolus and the work is transferred to the joint.

What are the structures furthest from the fulcrum in this lever?

The teeth.

What teeth?

The anterior teeth.

This could be the reason why the anterior teeth are the last to be lost. It can also be a reason why the occlusion protected by an anterior guide works. If you have a resistant bolus, where the teeth cannot penetrate the bolus, such as in a kernel (Fig. 26), then you will have what a fulcrum transfer. The resistant bolus will become the fulcrum and the work (resistance) will be produced at the level of the joint. It is still a third-class lever, but in this case, the work will be produced in the joint, which becomes subject to load. And that's why if we build the occlusion with prematurity, we can cause enormous damage.

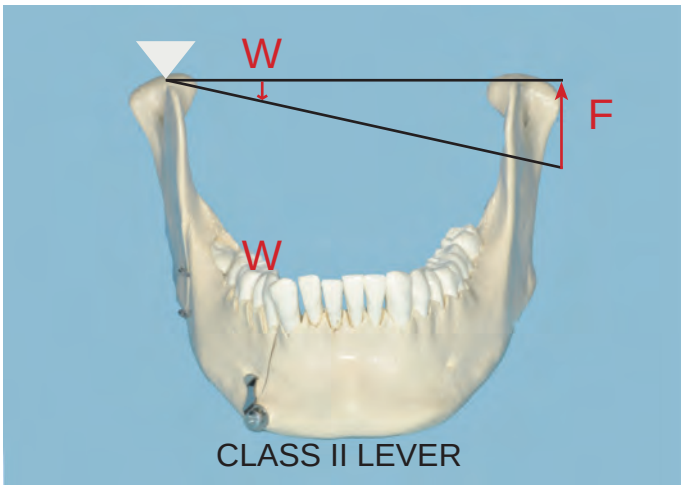

Fig. 27 Second class lever. Front view of the mandible. Right working side: fulcrum (▼), resistance or work (W), and force (F).

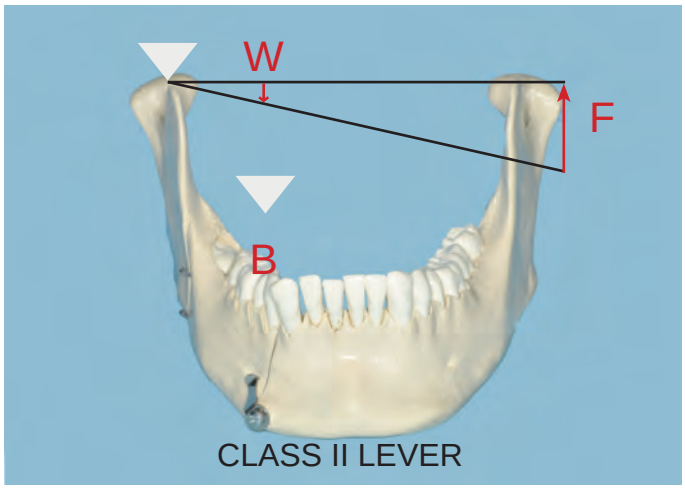

Fig. 28 Second class lever. Front view of the mandible. Right working side: the position of the bolus (B), which becomes the fulcrum, changes the class of the lever, from the II class lever to the I class lever.

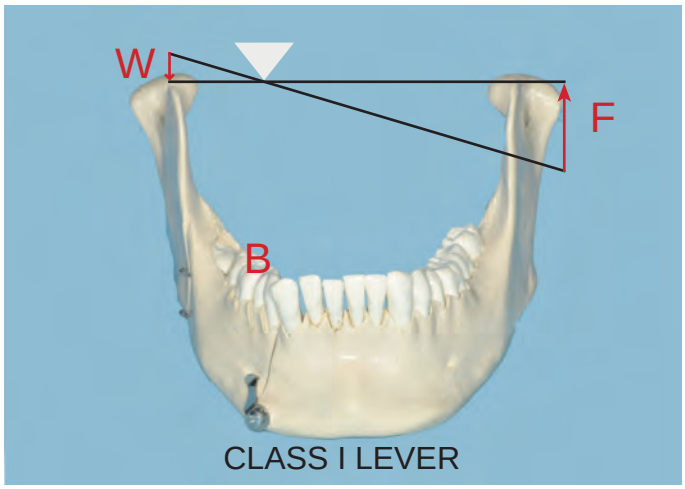

Fig. 29 First-class lever. Front view of the mandible. Right working side: the position of the bolus (B), which becomes the fulcrum (▼), changes the class of leverage from 2nd class to 1st class.

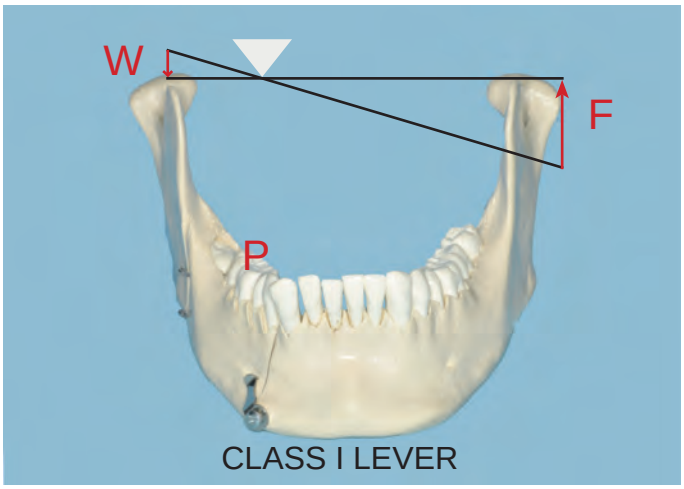

Fig. 30 First-class lever. Front view of the mandible. Right working side: instead of the bolus there is prematurity (P). This is the reason prematurity can cause harm because it converts the system.

Which prematurity you have been taught is the most dangerous?

The posterior.

On which side?

On the non-working side.

We look at the mandible from the frontal plane. We select the fulcrum on the working side (Fig. 27). Then the fulcrum will be on the condyle, for example on the right. The force will be given by the masseter and the temporal muscles, which are the most powerful, in a lateral position opposite to the joint. The work produced will be on the working side teeth, which is the right side. Thus, we have fulcrum (▼), resistance or work (W), and force (F).

Which class is this lever?

Second-class.

Let us now consider that B is the bolus (Fig. 28).

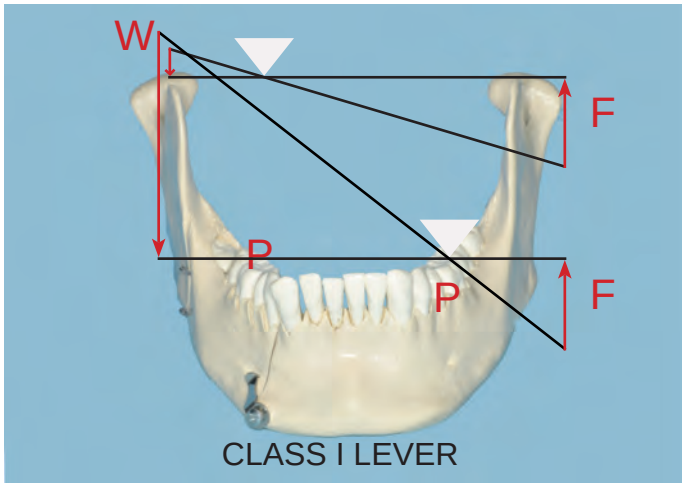

Fig. 31 Front view of the mandible. Right Working Side: prematurity (P) is now on the non-working side. It is still a class I lever, but now the damage is greater because the path performed in the right joint is greater than before (see Fig. 30).

So what happens?

That becomes the fulcrum (Fig. 29).

Where is the work?

In the temporomandibular joint.

And where is the force? Where it was before.

What class is this lever?

It is a first-class lever (Fig. 29).

This is the most efficient lever, but it is also the most dangerous, and the most harmful because it is the most powerful. In this situation, everything is fine because we are chewing soft food (Fig. 29).

Now we consider that in place of bolus B there is a prematurity P (Fig. 30). Even prematurity becomes a fulcrum. This is the reason the prematurity can cause damage because it converts the system into a first-class lever.

This event can happen when we build a prematurity with any treatment, with a filling or with a crown, and we don't see it. Remember that maximum force and maximum speed are exerted immediately before tooth contact. So what's going to happen? That the filling will break, that the ceramic will splinter, that the implant will break or that the tooth will break.

If the rise is important, the patient will report it. But if the rise were small, anyhow the restoration will arrive sooner, and if the patient will doesn't notice it immediately or will say he doesn't feel it, and if the dentist doesn't seek the exactness of that occlusion, then, precisely because the contact will take place when the maximum force and maximum speed are exerted, serious damage could be generated, not only of fracture of the

restoration and repetition of the work, but also of a lesion to the temporomandibular joint and, with the times that run, the dentist will also have medical problems legal.

Now we place the prematurity on the non-working side (Fig. 31).

Where is the force?

In the same place.

The fulcrum is in P to the left of the patient.

Where is the work?

In the temporomandibular joint.

What lever is it?

It is still a first-class lever. But since the fulcrum is closer to the force, the path taken at the other end of the lever, in the temporomandibular joint, is greater. Hence, it has the ability to create more damage. This is the reason why a prematurity on the non-working side has greater damage potential than a prematurity on the working side.

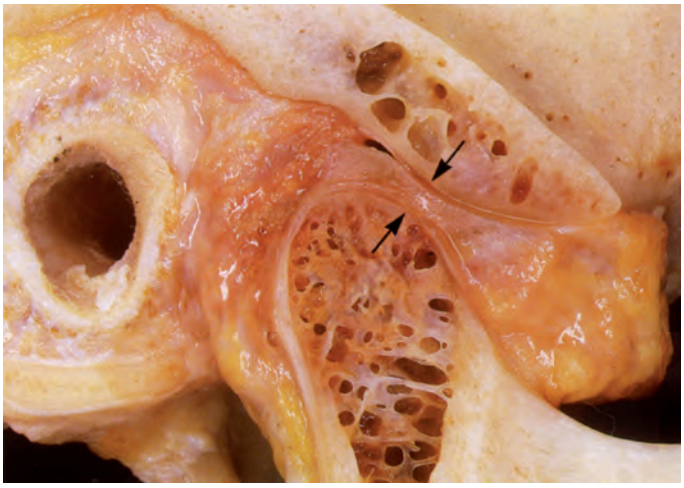

Fig. 32 Anteroposterior section of the right temporomandibular joint in the cadaver, view with the mouth closed[1]. Note the articular cartilage from the anterior border of the glenoid fossa, on the tubercle, to the articular tubercle, and the articular cartilage on the anterior part of the upper surface of the condyle and on its anterior face. The middle part of the disc is the thinnest.

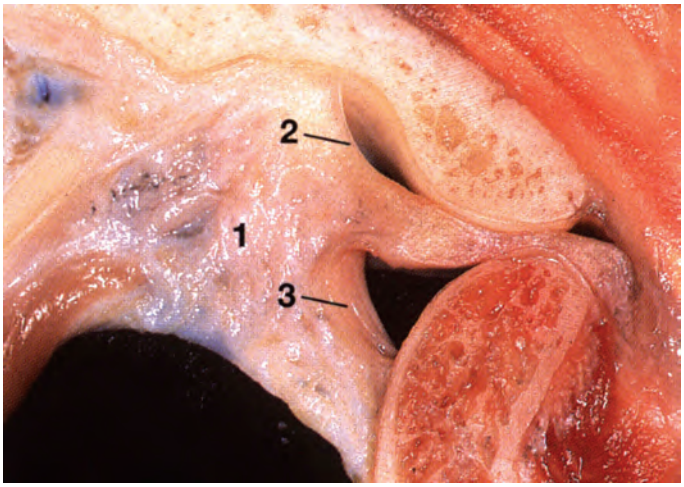

Fig. 33 Anteroposterior section of the right temporomandibular joint in the cadaver: open-mouth view[1]. Note the vascular area (1), the superior joint space (2), and the inferior joint space (3).

Now let's look at a section in a corpse of the right temporomandibular joint with the mouth closed (Fig. 32). We see the articular cartilage on the anterior surface of the joint cavity and on the anterior surface of the condyle. We also see the articular disc.

Let's look at a section in a corpse of the right temporomandibular joint with an open mouth (Fig. 33). Let's see the articular disc. We see that there are two compartments in the joint: the superior synovial compartment and the inferior synovial compartment. The upper part of the joint consists of the set of condyle and disc, or more specifically the upper part of the disc and the lower part of the joint roof. The only possible movement in this compartment is translation. The lower compartment includes the joint of the condyle independently of the disc, or more specifically the upper part of the condyle and the lower surface of the disc. The main movement allowed in this segment of the joint is rotation. However, translation movements may also occur, due to slight mobility or loss of stiffness of the medial and lateral disc ligaments to the condyle. This means that there may be a small amount of translational movement before the condyle and disc begin to move. These are the translational movements and most likely also a part of the immediate Bennett movement (immediate side shift).

Types of movement

We talked about joints and levers. So we are talking about a system of rigid bodies and there are rules that govern the movement of rigid bodies. Regarding rigid bodies, there are three types of movement:

1. rotation
2. translation
3. plane movement

Let's talk about rotation. Remember that joints are levers' systems. The main movement of any lever is rotation. To understand the rotation, let's imagine a sphere inside a ring. We spin this

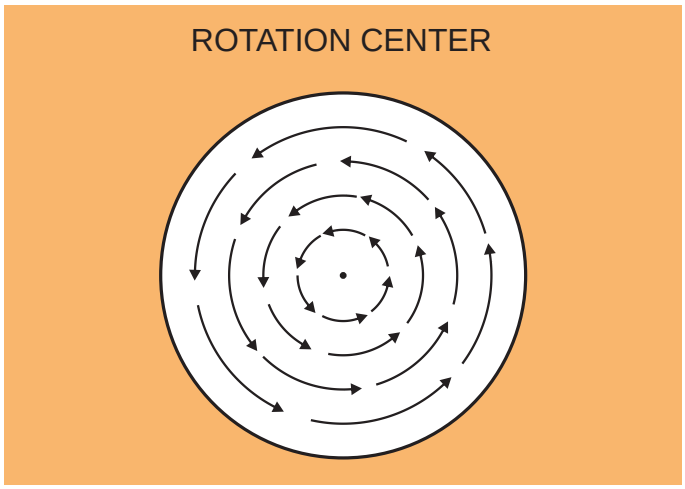

Fig. 34 Rotation and center of rotation in a spherical body.

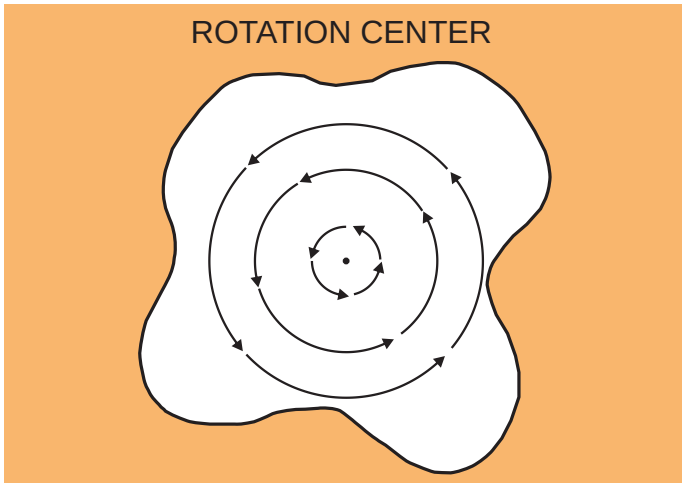

Fig. 35 Rotation and center of rotation in an irregular body.

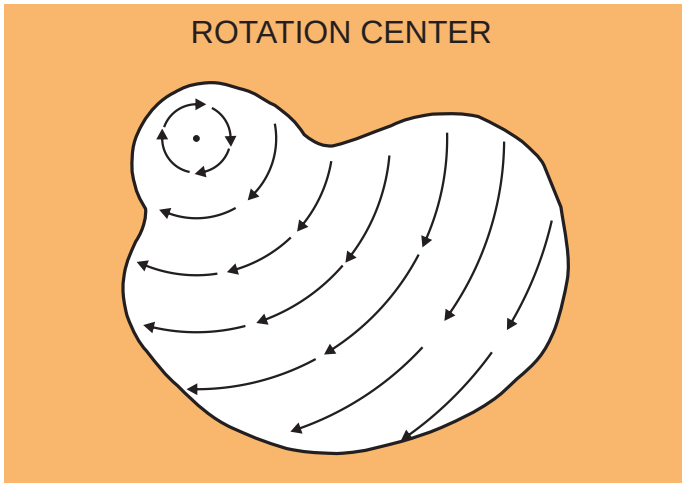

Fig. 36 The center of rotation does not necessarily have to be in the center of the body.

sphere and we see that it is suspended inside its ring, like a bearing. When you rotate this sphere, the most central part remains constant with respect to the periphery, to the ring that surrounds it. This is called the center of rotation. By definition, the center of rotation is fixed. In that picture, we see the center of rotation of a sphere and because the shape is spherical, it is capable of rotating for 360° (Fig. 34). The arrows represent the paths of points or particles contained within the spherical body. When an engineer looks at a body, he sees this body as a collection of points and particles. We notice that these points or particles as they move away from the center of rotation, describe increasingly wider arcs; the closer we get to the center, the smaller these arcs will be. This is another way of saying “the longer the radius, the wider the circle”.

Rotation is a circular motion. The body does not need to be regular to rotate. The irregular body can also rotate, but it cannot rotate 360° (Fig. 35). In this case the center of rotation does not necessarily have to be in the center of the body, it can also be completely shifted to one side (Fig. 36).

Hinge axis

Each body is capable of rotation. We can show that there is a center of rotation in the right condyle and a center of rotation in the left condyle and if we connect these two centers of rotation, we have a line along which the mandible can rotate. This is also called the hinge axis or more precisely the horizontal axis or the transversal axis of rotation (Fig. 37). The question arises: “Why do we need this axis?” The answer is: “Why do we have to use an articulator.”

That figure (Fig. 38) represents a mandible with registration in centric relation by using a wax between the teeth. We see the teeth with wax and the center of rotation is in the center

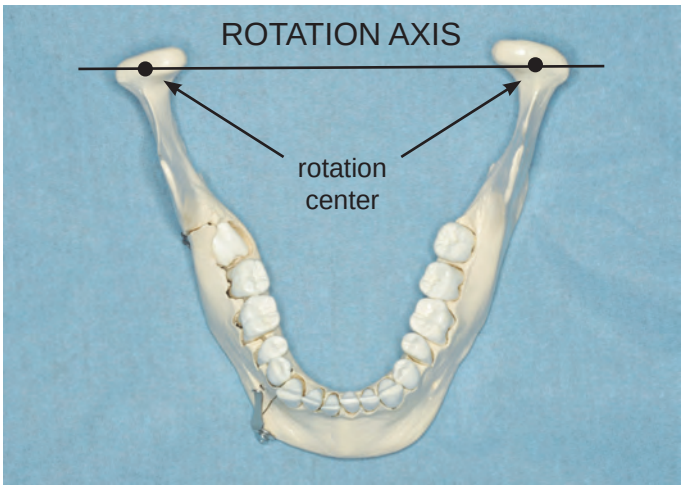

Fig. 37 There is a center of rotation in each condyle and if we join them we get a line along which the mandible can rotate.

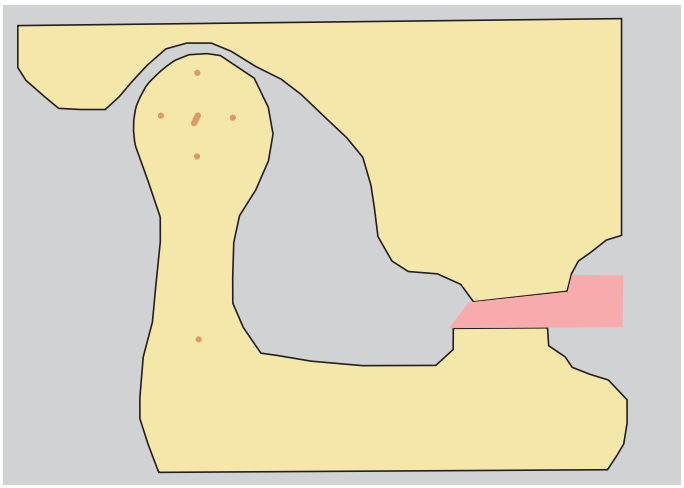

Fig. 38 Registration in centric relation (wax between the teeth) with the center of rotation in the center of the condyle.

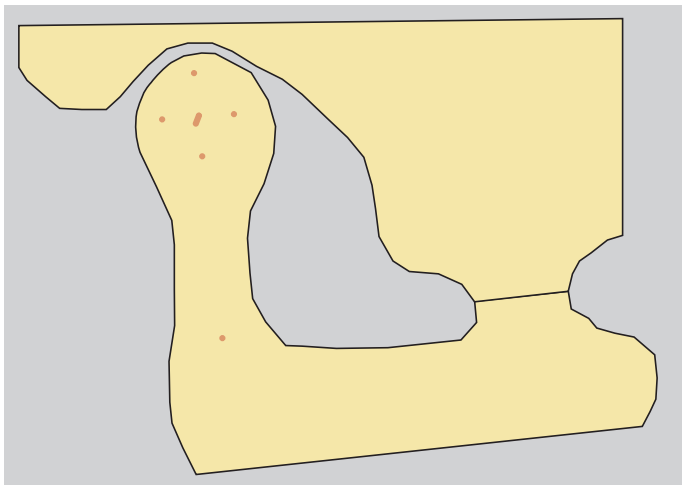

Fig. 39 After removing the wax, closing and contact of the teeth with the center of rotation in the center of the condyle.

of the condyle. When we take a centric relation registration, we take it to an increased vertical dimension.

We need to know which teeth close in this position, that is where the teeth touch each other when we remove the registration plate. But can the mandible close on the same arch that the patient closes when we manipulate this closure with hands?

We remove that registration plate, we have closure and contact (Fig. 39).

Now we take the same centric registration, on the same patient and transfer it to an articulator. We see that the center of rotation of the articulator is not in the center of the condyle, as in the patient's horizontal axis, but is at the bottom in the angle of the mandible (Fig. 40). So now we remove the registration wax and close the articulator mandible (Fig. 41). We now have an error. That picture is the magnification front view, where we highlight the error (Fig. 42).

Now let's do the same example.

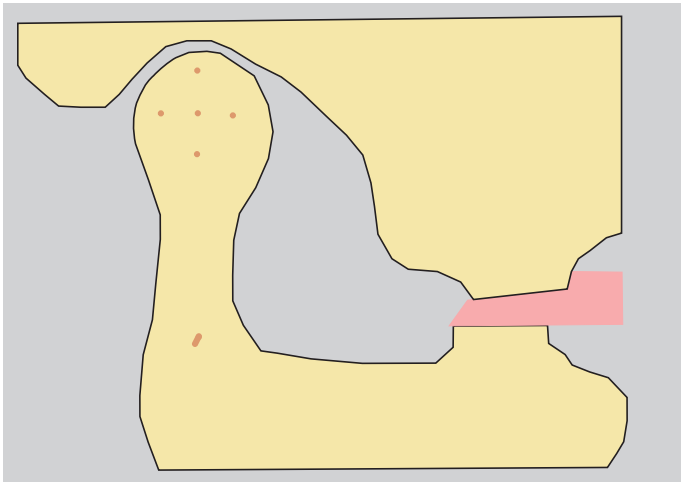

Fig. 40 Registration in centric relation (wax between the teeth) with the center of rotation in the angle of the mandible.

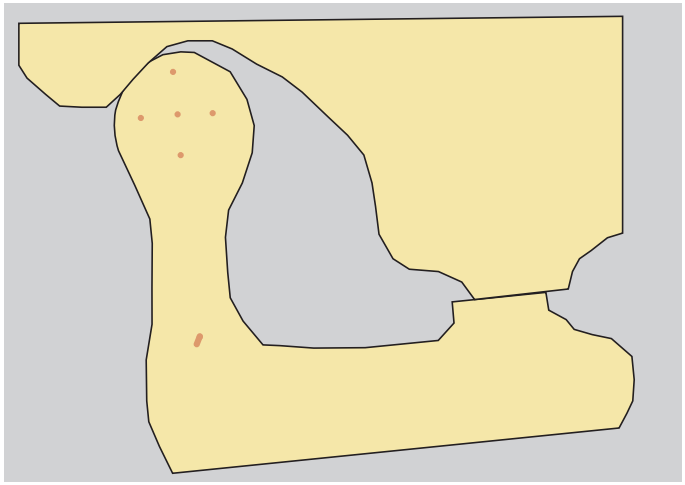

Fig. 41 After removing the wax, closure of the teeth with the center of rotation in the angle of the mandible. There is a big mistake.

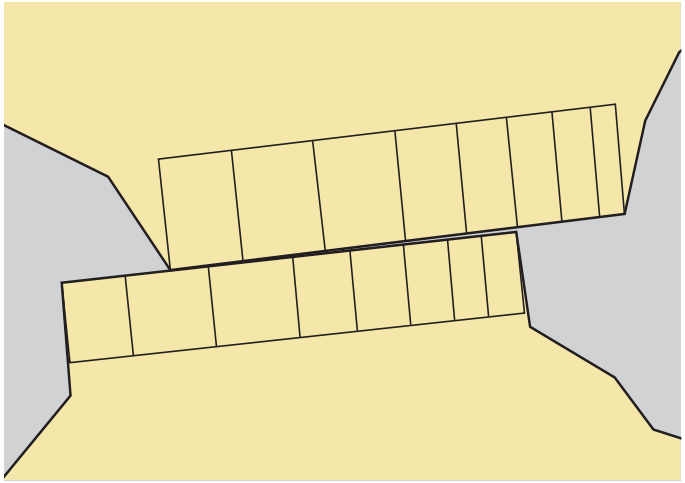

Fig. 42 Magnification of Figure 41. Notice how large the error is if the rotation occurs in the angle of the mandible.

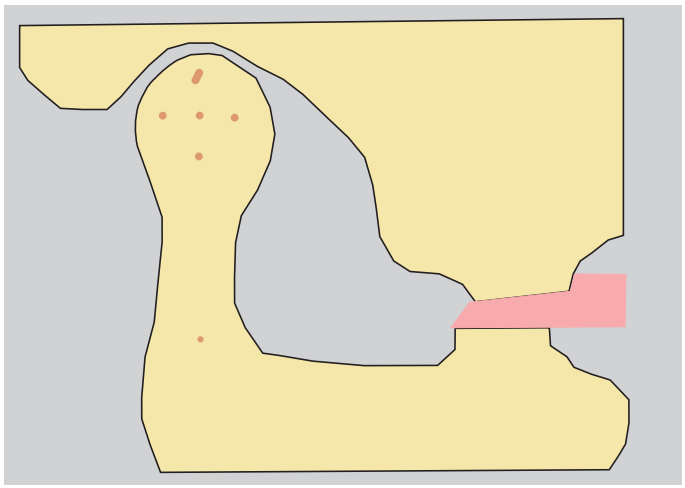

Fig. 43 Registration in centric relation (wax between the teeth) with the center of rotation up, over the center of the condyle.

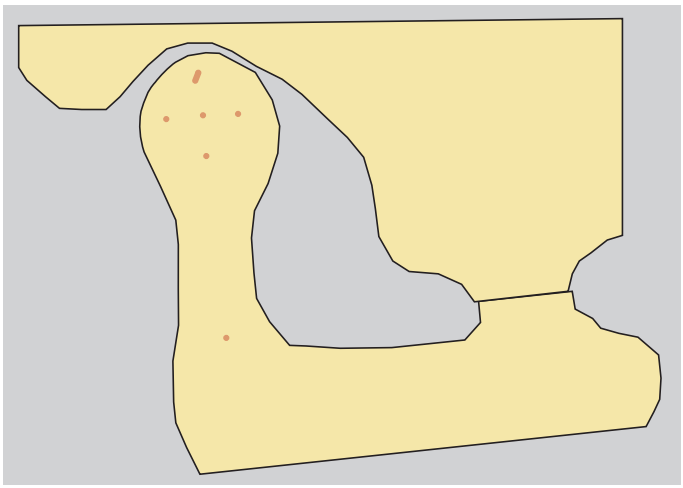

Fig. 44 After removing the wax, closure of the teeth with the center of rotation up, above the center of the condyle. One more mistake.

Let's say that before we used an inadequate instrument because the center of rotation in the angle of the mandible is inaccurate.

Now let's take a more suitable instrument and

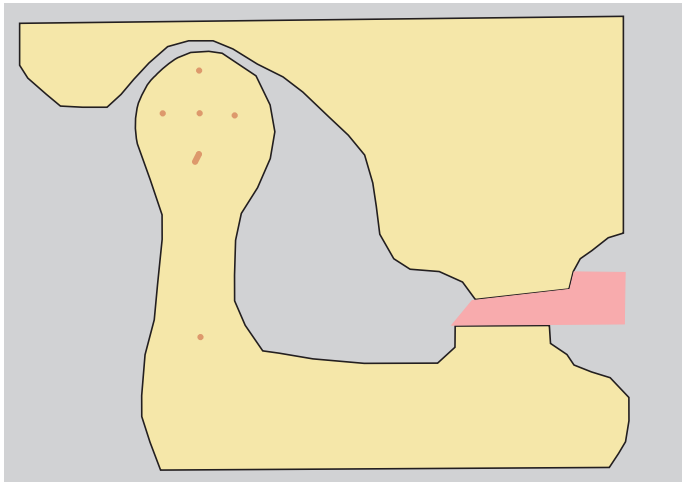

Fig. 46 Registration in centric relation (wax between the teeth) with the center of rotation under the center of the condyle.

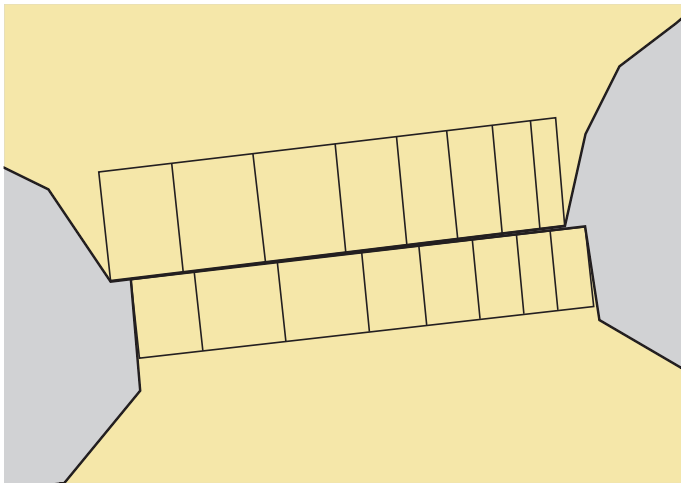

Fig. 45 Magnification of Figure 44. Notice the error if the rotation occurs not in the center of the condyle, but above the center.

we find that the center of rotation is not exactly the ideal one, but a little higher, not in the center of the condyle, but a little higher, with a small error (Fig. 43).

Removing the registration wax we have an error with the movement of the mandible more for-

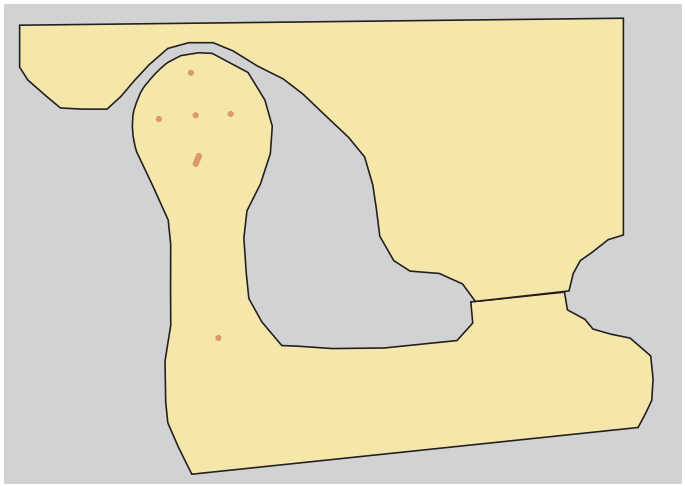

Fig. 47 After removing the wax, close the teeth with the center of rotation below the center of the condyle. One more mistake.

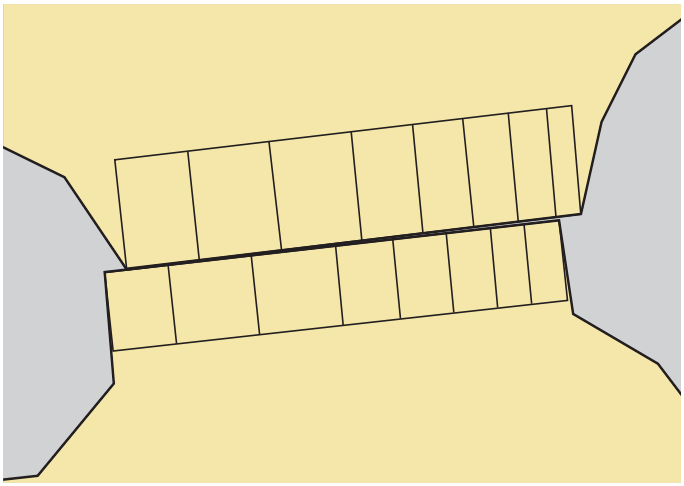

Fig. 48 Magnification of Figure 47. Notice the error if the rotation occurs not in the center of the condyle, but below the center.

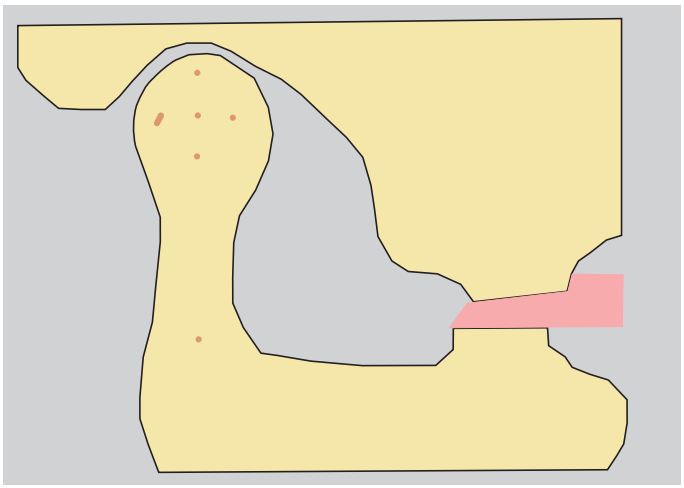

Fig. 49 Registration in centric relation (wax between the teeth) with the center of rotation behind the center of the condyle.

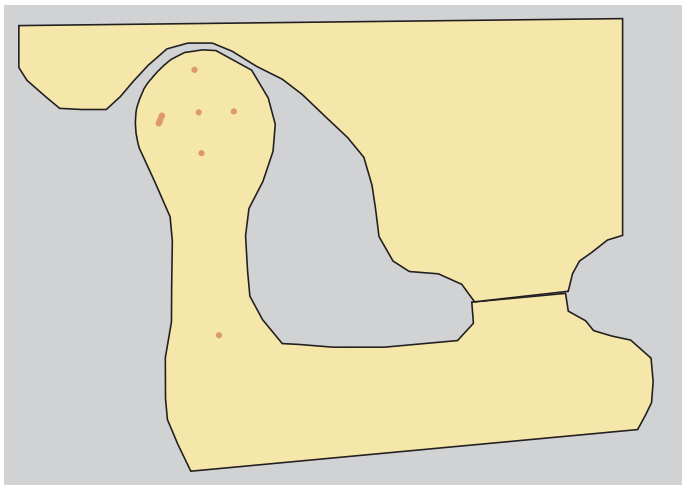

Fig. 50 After removing the wax, closure of the teeth with the center of rotation behind the center of the condyle. One more mistake.

ward than that which occurs in the mouth (Fig. 44). That is the magnification (Fig. 45).

And it is equally a mistake, albeit a minor one than before.

Now suppose the center of rotation is below the center of rotation in the condyle (Fig. 46). If

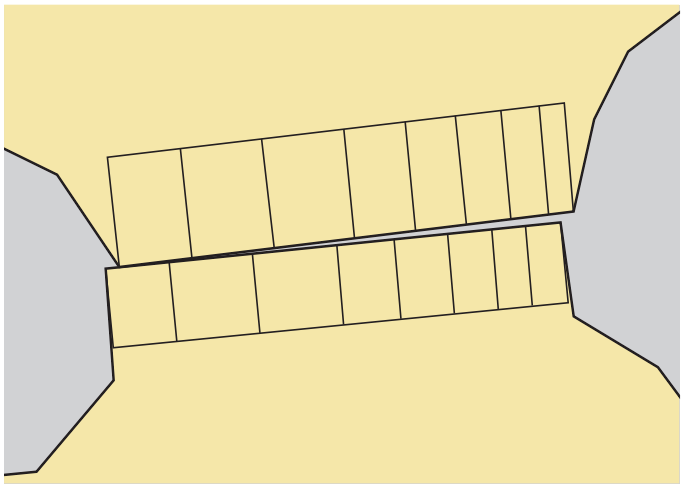

Fig. 51 Magnification of Figure 50. Notice the error if the rotation took place not in the center of the condyle, but behind the center.

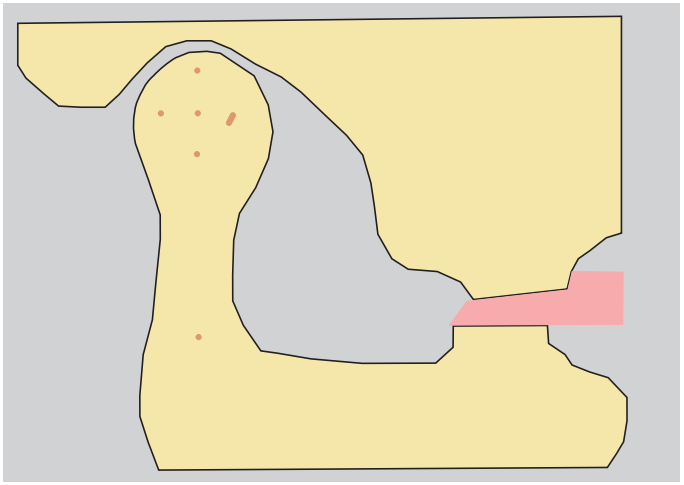

Fig. 52 Registration in centric relation (wax between the teeth) with the center of rotation in front of the center of the condyle.

we register an axis below the center of rotation, we have, by removing the wax, a centric registration in a more retruded mandibular position (Fig. 47). We close. Even now there is an error (Fig. 47). And that is the magnification (Fig. 48).

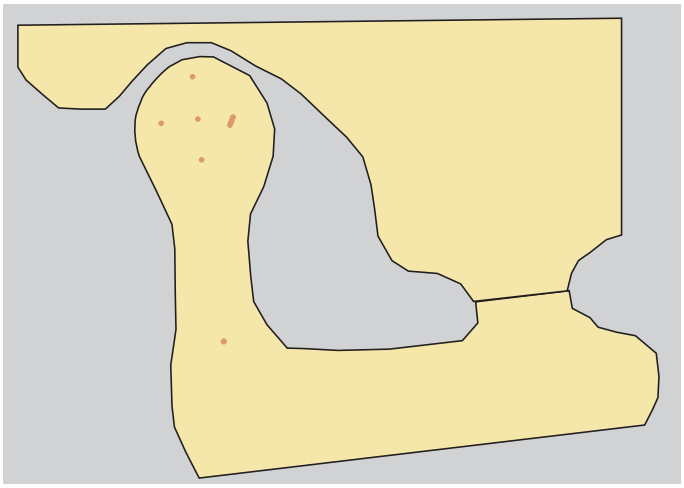

Fig. 53 After removing the wax, close the teeth with the center of rotation in front of the center of the condyle. One more mistake.

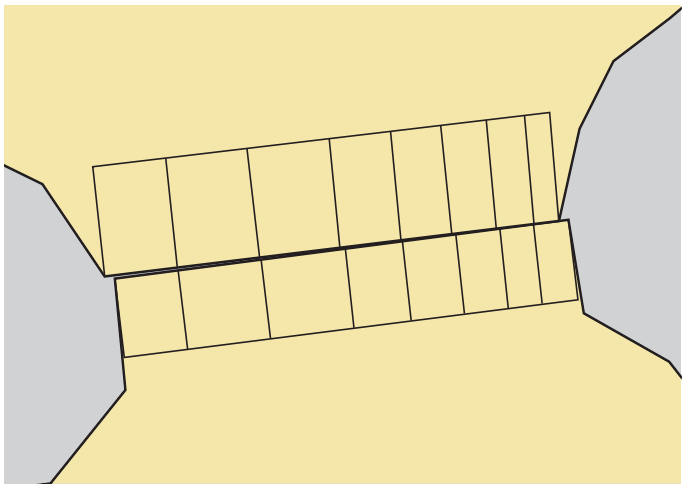

Fig. 54 Magnification of figure 53. Notice the error if the rotation took place not in the center of the condyle, but in front of the center.

And if instead, we register it further back (Fig. 49) we will have a small error even now. We will have a more back mandibular position, a posterior prematurity and an opening between the anterior teeth (Fig. 50). And that is the magnification (Fig. 51).

And if we register it further ahead (Fig. 52) we will have a more anterior position.

We close. There is still an error (Fig. 53).

And that is the magnification (Fig. 54).

In the examples shown above, we had flat surfaces. Now suppose we have an anatomical

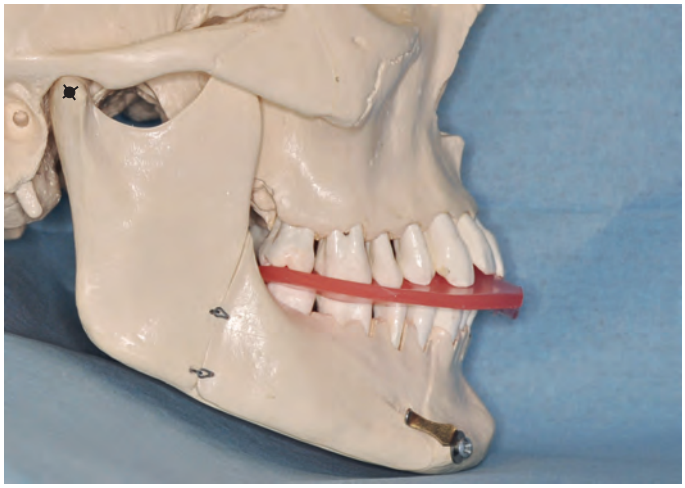

Fig. 55 Registration in centric relation (wax between the teeth) with the center of rotation in the center of the condyle.

Fig. 56 After removing the wax, closure, and contact of the teeth with the center of rotation in the center of the condyle.

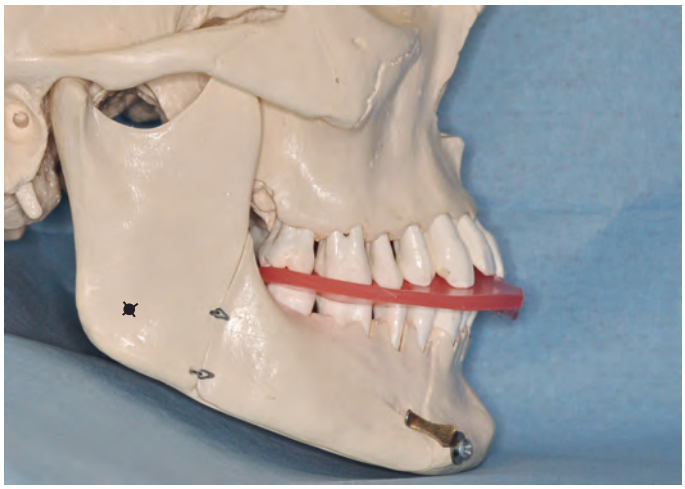

Fig. 57 Registration in centric relation (wax between the teeth) with the center of rotation in the angle of the mandible.

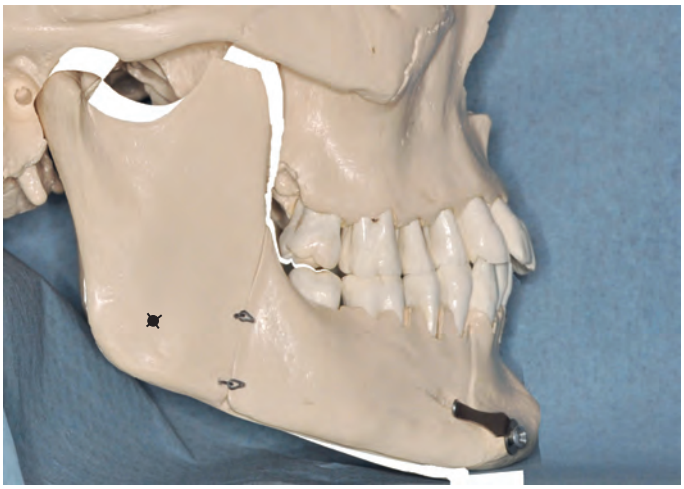

Fig. 58 After removing the wax, closure of the teeth with the center of rotation in the angle of the mandible. There is a big mistake.

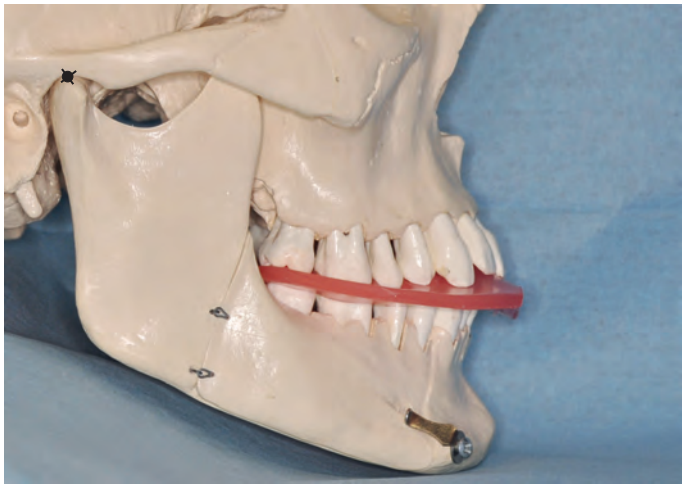

Fig. 59 Registration in centric relation (wax between the teeth) with the center of rotation at the top, above the center of the condyle.

Fig. 60 After removing the wax, closure of the teeth with the center of rotation up, above the center of the condyle. One more mistake.

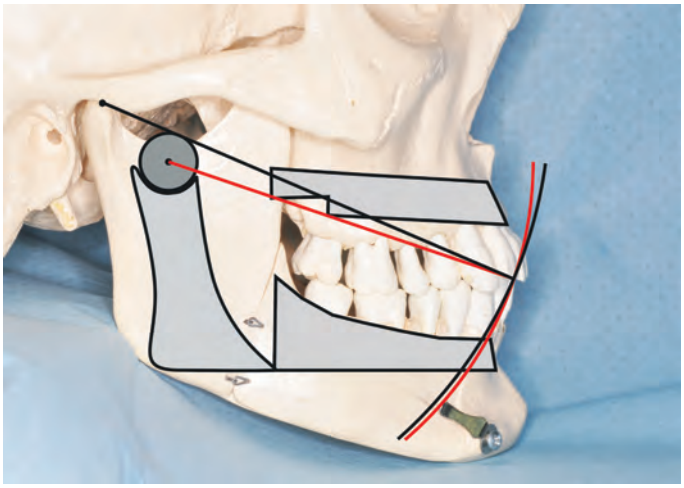

Fig. 61 Distance, the radius of closure, between the center of rotation, located in the condyle, and the teeth. This distance, or closing radius, must be the same in the patient and in the articulator.

shape and that is the registration (Fig. 55).

We remove the wax, close the mandible, and we see that the teeth come into contact with each other, because the center of rotation is always the same (Fig. 56).

But if we have an instrument in which the center of rotation is at the bottom in the angle of the mandible, we have a big mistake (Fig. 57).

And that is the mistake (Fig. 58).

And if the center was high above the center of the condyle, another mistake (Fig. 59). And that is the closure after removing the wax (Fig. 60).

I tried to show you that there is a distance, a length of the closing radius of these teeth, which must be the same both in the patient and in the articulator.

If this closing radius is not the same in the patient and in the articulator (Fig. 61), the more you change the vertical dimension, the greater the error will be. The wax has a certain thickness. The technician fixes the models on the articulator in the position established by the wax and when removing the wax, the models are detached from each other by a distance equal to the thickness of the wax (see Fig. 99 page 44). Then he closes the articulator and puts the models in contact. If the closing radius of the articulator is not equal to the patient's closing radius, there will be an error. And that is why when you insert the crown into the patient the crown is high. This is one of the reasons. So the first question that follows is this: "How can we reduce errors?" The answer is: "Using the face bow". This is the purpose of the face bow.

What are you doing when using a face bow?

What is the procedure and what are you trying to transfer from the patient to the articulator using the face bow?

What do you transfer?

Many think of transferring the transverse axis of rotation. You are not transferring the axis. The articulator has an axis. You are transferring the radius and when you transfer the radius of the arc, the axis of the articulator coincides with the axis of the patient, that is, the axis of the articulator is collinear with the axis of the patient. Many people think of transferring the rotation axis, but they are wrong.

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Piergiorgio Pasotti, MD DDS MSD

- Medicine and Surgery Doctor
- Dentist, Prosthodontist and Gnathologist
- Medicine and Surgery Degree, Milan University (Italy)
- Qualified to practice the profession, Milan University (Italy)
- Specialization Degree in Digestive System Surgery and Digestive Endoscopy, Milan University (Italy)
- 2nd Level European Master Degree of Laser in Odontostomatology (EMDOLA Project, European Master Degree on Oral Laser Applications), Parma University (Italy)
- Diploma in Microsurgery and Microsurgical Techniques, Brescia University (Italy)
- Diploma in Orthodontics Tweed Merrifield Technique EPGET (European Post Graduate Course in Edgewise Technique), GMS Vigevano (Italy)
- Diploma in Advanced Dental Surgery and Anatomical Dissection of the Mouth, Liege University (Belgium)
- Student of Prof. Frank V. Celenza, whose courses he attended in Occlusion, Occlusal Morphology, Construction of the Occlusion and the Prosthesis, expert and popularizer of his teachings, supporter of the Occlusion importance in the dental profession
- Teacher of Total Prosthesis at the Magistral Degree Course in Dentistry and Dental Prosthesis, Brescia University (Italy)
- Teacher of Occlusion Physiology at the Master of Oral Surgery and Pathology, Parma University (Italy)
- Teacher of Occlusion Physiology at the 2nd Level European Master Degree of Laser in Odontostomatology (EMDOLA Project, European Master Degree on Oral Laser Applications), Parma University (Italy)
- Author of the book “Fisiologia dell’Occlusione, di Frank V. Celenza”, Italian version (Italy)
- Author of the book “Testo Atlante di Protesi Totale”, Italian version (Italy)
- Author of National and International Publications
- Speaker at National and International Congresses
- Member of the Italian Academy of Prosthodontic Dentistry (Italy)
- Member of the Italian Academy of Implant Prosthesis (Italy)
- Freelance Dentist, Prosthodontist and Gnathologist
- Teacher and lecturer on Occlusion Physiology, Fixed Prosthesis on natural teeth, on implants or mixed, Mobile Skeletonized Prosthesis, Combined Fixed Mobile Prosthesis, and Total Prosthesis in Italian and Foreign training courses

Abstract

The way in which the teeth meet is called occlusion and the people who attribute to themselves the philosophy of measuring and recording the movement of the mandible, which essentially leads to the development of dental occlusion, were called Gnathologists. The structures involved in the occlusion are the temporomandibular joint, the teeth, the mastication muscles, the nerves that control the muscles, the adjustment and feedback systems, and the position of the head.

Building the occlusion is not a logical, intuitive, obvious, banal, automatic action, or thinking that it is enough to put the dental surfaces in contact, taking care to prevent them from bothering each other, that they do not touch before others. To learn and know the occlusion is very important. It is impossible to treat the occlusion in a few pages and even will not be enough some days.

The dentist must know the occlusion not only to construct prostheses but also to correctly perform conservative treatments. The prosthodontist is the dentist. The dental technician is not the prosthodontist. The technician is a performer, who realizes what the dentist asks him and with the means that the dentist gives him. The dentist must provide the dental technician with the information and means he needs to create correct prostheses.

Only if there is an agreement between the dentist and dental technician, no one will have problems, and above all the patient will not have them. Have you wondered why fillings break, why ceramics chip, why implants break or move, why full dentures move, why they create enormous pain and injuries? It is always the fault of the wrong occlusion. We are the cause of these events, it is not a material defect or an error by the dental technician. For some time there has been talking of temporomandibular dysfunctions, and courses on temporomandibular dysfunctions are organized. But temporomandibular dysfunction is not a contagious infectious disease. The cause is always the wrong occlusion.

The temporomandibular joint is an unloaded joint. When the teeth are in maximum intercuspation position, the joint is in a suspended position, three-dimensionally suspended, and it is asymmetrical. The function of the joints is not to load the teeth, rather it is a function of the teeth that unloads the joints. The teeth stop the closure and determine the final position of the joint. Many dentists think that the normal condition is the centric relation position. McCollum, the father of gnathology, stated that when this condition does not exist, patients suffer of periodontal disease. Now we know this is not true. The normal condition is that when a patient has a centric occlusion, he also has a centric relation. The centric relation is normal, but the teeth do not come in contact all together in the centric relation. The teeth come in contact all together in centric occlusion. When we make coincide the centric occlusion with the centric relation, then we create an occlusion in centric relation. But this is an abnormal position of physiological stop point, it is a prosthetic invention. We have created this.

There are five physiological factors that link dental contacts with the temporomandibular joint. We often talk about face bow, but few dentists know what it is for, when it is to be used, and when it is of no value. We talk about articulators, we discuss their usefulness, which is the best, but few dentists know when they can be used and when they are of no value. Few dentists know the meaning of the hinge axis and its importance in avoiding errors in the use of articulators. This book concerns these concepts extensively, explains the severity of prematurity contacts, both on the working side and, even more so, on the non-working side.

Occlusion has enormous importance, it does not only affect the prosthesis but concerns and involves all dentistry. Occlusion is where all disciplines meet, it is the central part of dentistry.

This book will clarify many doubts and will answer many questions, it will allow you to understand occlusion, the physiology, and dental restoration.

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