FUNDAMENTALS OF TREATMENT PLANNING

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Guidelines on how to develop, plan, write and deliver a prosthodontic care project

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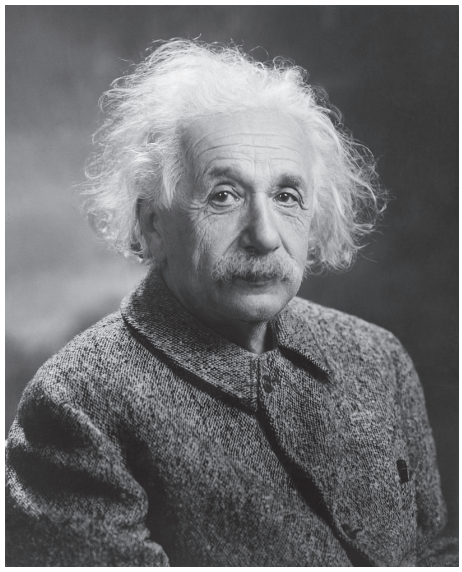
"Tristo Discipulo Qui Magister Non Superavit!"
"Bad is the student who won't do better than his teacher!"
University La Sapienza, Rome, Italy (founded in 1303)



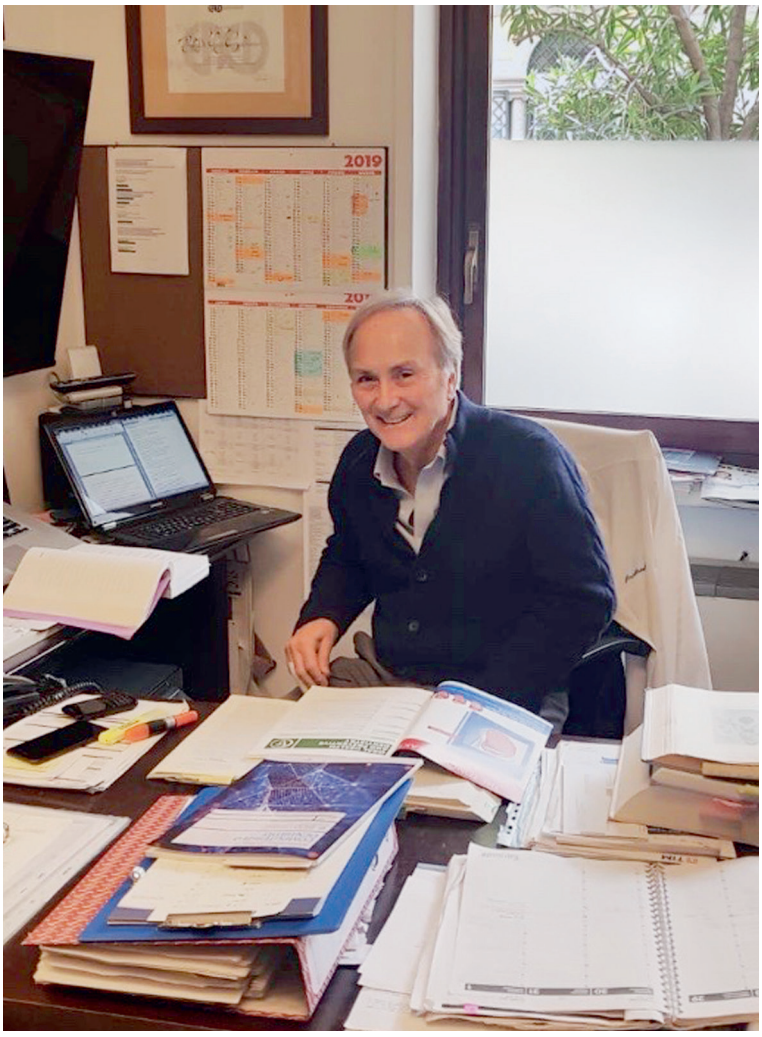
"Great spirits have always encountered violent opposition from mediocre minds. Imagination is more important than knowledge. Knowledge is limited; imagination encircles the world. Any fool can know, but the point is to understand.

I didn't arrive at my understanding of the fundamental laws of the universe through my rational mind. I have no special talent; I am only passionately curious.

Time is relative and its unique value is given by what we do as it passes.

Only a life lived for others is a life worthwhile."
Albert Einstein (1879–1955)

Dedication



As science teaches, the concepts expressed in this book were not written as a point of arrival of learning, but rather as a continuous progression of learning. This book is dedicated to all my beloved teachers who inspired me and who still enrich my life as I remind my students that knowledge always follows when you have passion and commitment.

Lino Calvani

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Foreword

What we know and do today creates the premises of our tomorrow.

A scientific book is like a mosaic, a complex of many chapters or tiles, each one with its color and meaning and specific position in the whole. However, when you look at a single tile you only see that particular color, whereas if you look at all the tiles you see the overall final composition. This book itself is a humble tile that is part of a much larger mosaic – medical care.

The specialty of prosthodontics was born almost two centuries ago in the United States of America, where it still evolves at a pace and level of complexity that is unknown anywhere else. Prosthodontic science is not an easy matter to deal with. It is probably the field of dental medicine that deals with the largest amount of medical, dental, clinical, and laboratory data. But even though it is complex, it is beautiful and requires humble passion and commitment to know it well. Recent discoveries and technological advances have increased the amount and quality of new treatment modalities. This may sometimes be misinterpreted as 'heavier' procedures, but in fact it is not. While the increasing wealth of information may appear to be overwhelming or very complex, it is really only a matter of putting in the constant effort of learning how to handle it. Fortunately, there are many new digital technologies available today that are helping us to achieve this. The entire preliminary before-treatment assessment that professionals in all fields of medicine and dental medicine have to commit to before they begin to care for a patient can be summarized in two simple words: treatment planning.

I wrote this book because while lecturing on the topic of prosthodontic treatment planning over the years I was asked to organize my notes and make them easily accessible to all students. The complexity of the topic and the enormous body of existing literature engaged me in a great effort of synthesis to rationalize and select the fundamentals. It was a challenge to avoid dipping too deeply into the various more philosophical ideas and notions that comprise this complex field, although some of these are touched upon in the text when necessary. However, analysis and description are the backbones of the book, and treatment planning is the basic scaffolding on which I have constructed the text. Treatment planning is the investigative and diagnostic phase where the clinician plans a well-structured, rational sequence of care steps in order to best treat each individual patient. And this aspect naturally expands in the book into defining and discussing many other aspects of prosthodontic work as well as possible collaboration with other related dental medical specialties that contribute to the rehabilitation of patients such as periodontics, orthodontics, endodontics, maxillofacial surgery, and other specialties.

Although the book primarily addresses prosthodontic specialists, it also explains basic matters relevant to all medical fields. Therefore, graduate and postgraduate students as well as general practitioners and specialists in other fields besides prosthodontics will hopefully find useful explanations and outlines that will make them aware of the various aspects and possibilities of medical and prosthetic treatment planning as it exists today. After all, medical and dental medical treatment plans have the same basic origin and structure.

I strongly believe that treatment planning should be elevated to the same level as other scientific medical fields such as anatomy and physiology and afforded the same respect and dignity. It should be taught and evaluated as a subject in its own right. Furthermore, in the study, discussion, and formulation of a treatment plan, practitioners should never place their own professional pride or economic interest before the best interests of the patient, whose health should always be the paramount issue. The needs of

every patient should be treated with respect. Every case deserves to be rehabilitated in full agreement with the patient.

Winston Churchill is credited with saying: *"He who fails to plan is planning to fail."* This refers to the logical premise that planning is essential in order to achieve success in human endeavor. Knowledge and organization are the main keys to success and make all the difference between professionalism and incompetence. For this reason, success in prosthodontics (as in most other human activity) depends on the amount and quality of our knowledge and how we plan to carry out the work we face – the detail of the where, when, and how of it – in order to predict and then achieve the best possible results.

The topic of this book is deeply rooted in medical ethics. As a board-certified physician, dentist, dental technician, and prosthodontist, over time I have become convinced that our professional duties go way beyond the limits of the teeth and the oral cavity.

Who we are is expressed by what we know and what we do, which is largely a matter of consciousness and awareness. The physical health of our patients is our primary goal; it is for this reason they seek our help. Apart from how patients take care of themselves, once they are in our offices their physical health largely depends on how well we perform our examinations, and how attentive and clever we are in detecting their condition/s and realizing how other physical ailments may be manifesting as dental problems. It is for this reason that we need to know our patients better from a broader medical perspective. A deeper understanding of how to conduct a physical examination of the head and neck area may be helpful and improve the way we work. The eyes, ears, nose, hands, and brain of the dental medical professional can not only help people to chew, speak, and look better, but also to live better, safer, and longer lives; in some cases, they may even save lives. As professionals we have to be conscious and aware of this because we work in the same medical field as physicians and surgeons, and we should all be able to perform a careful physical examination of the head and neck. The more we know and practice, the better able we are to take care of our patients.

I respectfully bring this book to the attention of all my young colleagues, both national and international, who may find the text helpful in order to form and organize their thinking and to formulate correct diagnoses and therapies that start with appropriate treatment planning. I will derive a little satisfaction if, with my effort, I am able to help clinicians and patients to improve their work and live better lives.

Lino Calvani, 2020

Acknowledgments

Thank you to my parents, Mario and Jole, beloved knowledgeable pediatrician and dentist. Your superb example and loving memories are always with me. You taught me to commit my profession to the exclusive interest of the patient and of science.

Thank you to my daughter, Ludovica, orthodontist, for your invaluable contribution, and to my son, Gianluigi, actor and playwright, for your helpful sensitivity and brainstorming capabilities. Thank you, dearest Francesca, for your love. I hope you will forgive me for all the private time I took from your lives. Thank you dear Avril, unique editor and friend, you are always able to teach me a lot.

Thank you to my endless list of teachers who have been beacons for me. I will always be your humble student.

Organization of the book and how to use it

The book is divided into 15 chapters that describe different aspects of prosthodontic treatment planning, from the first meeting with the patient to the delivery of the final prosthodontic treatment plan.

As you will see, each chapter describes a specific topic. Due to the complexity of the subject matter, many topics appear in more than one chapter. The reader is therefore provided with an index at the back of the book as well as cross-referencing throughout in order to reinforce the understanding of treatment planning.

Progressive explanations lead the reader to the last chapter, which contains a number of examples of how to write and describe a treatment plan.

The structure of the book is learner-friendly and will hopefully help readers to understand and memorize both the concepts and their functional rationale.

The following paragraphs present a short description of what you can expect from each chapter.

Chapter one: Past, present, and future of treatment planning

This introductory chapter, born from a curiosity to better understand how medical treatment planning came to be conceived, highlights the scientific aspects related to the development of treatment planning. Only the information that seems to have an obvious connection to the topic is discussed. The data show the clear growth trend of treatment planning in the western world. Possible future perspectives to date and in the foreseeable future are also touched upon. Due to the obvious restraints of the size and nature of this publication, much information has had to be omitted.

Chapter two: Treatment planning management

The purpose and aims of any treatment plan are explained and discussed in this chapter. Also discussed are the basis of respect for all patients; the priorities to be considered; the importance of clearly understanding the chief complaint/s that lead to patients seeking help; patients' understanding of their actual condition/s; the possibility of achieving an ideal treatment plan; the sometimes inevitable compromises that need to be clearly explained to patients to gain their understanding, awareness, and final approval; and the importance and possible limitations of the informed consent, which is the necessary final step before treatment begins.

Chapter three: Prosthodontic tools for treatment planning

This chapter describes the main restorative treatment options that exist in prosthodontics, which can be used as care tools to plan any type of rehabilitation. The chapter also includes a discussion of the rapid development of digital technologies and the impact of this on the field of prosthodontics, including the way in which our work has to be continually updated.

Chapter four: Data, findings, and dental semiotics

The topic of data and findings is discussed in the next chapter, including how, when, and why to collect and interpret their meaning. Signs and symptoms such as pain, fever, and hyperthermia are also defined and their diagnostic importance described. The semiotic clinical analysis is explained with regard to investigating the clinical signs that lead to a more complete diagnosis.

Chapter five: The first visit – diagnostics

The aims and significance of the first visit are elaborated upon in this chapter. A description is given of the different types of practical techniques that are used to gather information about patients. Also delineated is the diagnostic information that needs to be gathered and assessed during the first visit such as the patient's chief complaint/s; personal,

medical, dental, and prosthodontic history; and psychologic profile. The development of the initial part of the treatment plan, the management of emergencies, and the restorative planning are also described.

Chapter six: Diagnosis and prognosis

The meaning of the diagnosis, the differential diagnosis, and the prognosis are detailed in this chapter as well as their importance to the positive outcome of the prosthodontic treatment. The pretreatment and posttreatment prognoses are analyzed, and the periodontal, prosthodontic, and orthodontic etiology and risk factors that may impact the timing of the prognoses are also described.

Chapters seven and eight: Physical examinations

These two chapters on the medical examination present a step-by-step description of the basic procedures and methods that need to be applied when examining patients, starting from the first moment of engagement with the patient and following with the chairside examination at the first visit. Useful descriptions of all the most important extraoral and intraoral anatomical features are provided, together with their clinical and prosthodontic relevance and importance. The semiotic possibilities of these examinations are also evaluated.

Chapter nine: Main clinical examination assessment questions

This chapter continues the topic of examinations. It details the clinical intraoral and extraoral examinations and their importance in evaluating and assessing patients' health status and possible past and ongoing conditions. This can be considered an important juncture in the clinician–patient relationship, which can decide whether we gain patients' trust or lose them as patients; the procedures and suggestions in this chapter are therefore crucial.

Chapter ten: The type and structure of prosthodontic treatments

This chapter describes, analyzes, and proposes a new and original classification for prosthodontic treatment types according to the three main possible clinical variables: pure prosthodontic rehabilitations, those in collaboration with other specialists, and the presence of disease.

Chapters eleven, twelve, and thirteen: Treatment planning analysis of complex rehabilitations

The timing and organization of the different phases comprising a prosthodontic treatment plan are described and analyzed in these three chapters. Each of the three phases is explained with a view to understanding the priorities and to better organize the sequence of the phases in order to simplify the analysis and narrative description of a treatment plan. Also explained is the importance of integrating the radiographic and cone beam computed tomography (CBCT) diagnostic examinations to better define the final diagnosis.

Chapter fourteen: Treatment planning for the elderly and those with challenging health conditions

This chapter deals with the topic of treatment planning for elderly patients and those with drug addictions. Included are observations on how the body and oral cavity age, and how medicines and drugs influence and affect patients and, in turn, the effect this has on medical or dental treatment plans. Also shown is how the changes of aging can significantly affect a prosthodontic treatment, so that alternative solutions need to be planned according to the patient's needs. Discussed too is how transitory or chronic major conditions may modify a patient's capability to withstand an oral rehabilitation. A description and analysis are given of the most important drugs and how they may cause addiction as well as how they affect and influence oral treatment choices.

Chapter fifteen: How to write a prosthodontic treatment plan

The final chapter describes why and how treatment plans can be presented for in-office purposes or for

PowerPoint or Keynote presentations. A number of useful clinical case narratives are presented as practical treatment planning examples that could be used for the purposes of university case presentations and examinations, meetings, congress presentations or lectures. The 'narrative frameworks' of all the narrative reports explain the rationale behind why certain decisions have been made while other choices have been avoided, and how this rationale can be explained to patients, to other professionals or to students during seminars.

Prosthodontists: Who we are and what we do

"The world moves in front of them who know where to go and what to do."
Lino Calvani

I approached this profession and specialty with infinite humbleness, respect, curiosity, and commitment, and this is what still pushes me forward with passion. Prosthodontics is a beautiful, complex, and very demanding specialty in terms of knowledge and commitment. I have been moved to see in the literature how many have dedicated so much of their lives to its development and success. The list of literature that follows (in alphabetical order) is a small but highly representative sample of the significant writings dedicated to the growth and development of prosthodontics. The amazing professionals who have written these articles, papers, and books, and the many others who are not included in this list for reasons of space, have set a standard of passion and professionalism that is difficult to match.

The specialty of prosthodontics was originally recognized in 1948 by the Commission of Dental Accreditation (CODA), an independent agency of the American Dental Association (ADA), which is an independent organization recognized by the United States Department of Education.

The ADA defines prosthodontics as: *"the dental specialty pertaining to the diagnosis, treatment planning, rehabilitation, and maintenance of oral function, comfort, appearance, and health of patients with clinical conditions associated with missing or deficient teeth and/or oral and maxillofacial tissues using biocompatible substitutes."*

During the three years of training in all United States postgraduate prosthodontics specialty programs, students must become knowledgeable in the comprehensive treatment of clinical cases for missing or deficient teeth and oral and maxillofacial tissue in order to competently find solutions and cures using biocompatible substitutes. The focus is on the following areas:

1. Patient assessment (both medical and dental history).
2. Extraoral and intraoral examination.
3. Radiologic assessment and occlusal analysis.
4. Temporomandibular joint (TMJ) assessment.
5. Systemic, infectious, and neoplastic disease screening (education for prevention).
6. Diagnosis.
7. Risk assessment and prognosis.
8. Treatment planning.
9. Comprehensive treatment.
10. Outcomes assessment and delivery.
11. Follow-up and maintenance.

As professionals, we 'profess' to believe in who we are and what we do. As the Mission Statement of the American College of Prosthodontics states: *"Prosthodontists are specialists in the restoration and replacement of missing teeth and oral/facial structures with natural, esthetic, and functional replacements. This includes surgical implant placement, the simple to most complex implant-supported restorations, laboratory and clinical training in esthetics/cosmetics, crowns, bridges, veneers, inlays, removable complete and partial dentures, dental implants, TMD-jaw joint issues, traumatic injuries to the mouth's structures, congenital or birth anomalies and/or teeth, snoring and sleep disorders, as well as oral cancer, prosthetic reconstruction, and continuing care. Prosthodontists are experts in treatment planning."*

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CHAPTER ONE

Past, present, and future of treatment planning

"Those who do not learn from history are doomed to repeat it."
George Santayana (1863–1952)

"The past should be read with the eyes of present time."
Charles Darwin (1809–1882)

"The past is never dead. It's not even past."
William Faulkner (1897–1962)

The distant past

The author believes it is important to understand history not so much as a chronicle of events but in terms of the value we attach to and derive from these events. In this way, we arrive at the significance of the events. When we look back, we understand that for long millennia our civilization was not able to conceive or understand much about science, as we know it today. Certainly, in the distant past, people had absolutely no idea what they were doing when treating physical disease and illness.[1-4] But once in a while, a gifted individual with a 'beautiful mind' sensed something new, and in this way our knowledge was carried a step or two forward. Slowly there developed the understanding and acknowledgment that the causes of illness and disease were not so much 'divine' as they were natural or human-made, and this understanding was the route to healing them. Of course, the first medical treatments were simple natural herbal remedies, primitive bandages and cream prototypes, coupled with attempts of a philosophical or religious nature to explain and justify all incomprehensible events by relating them to the will of a moody God.[5-7]

In more recent history, after the 'static' middle ages (from a medical point of view), an increasing awareness of scientific evidence over the past five centuries has allowed for a better understanding of the mechanics of our nature and of the 'innate consciousness' and 'self-awareness' that distinguishes us as a species.[8-10] However, compared with other sciences, the development of medicine, including dental medicine, was more difficult because those bright-minded individuals who became involved had to face not only the extreme complexity and difficulty of the subject matter of the human body and mind, but also the limitations imposed by the endless short-sighted and ignorant doctrines of the time.[11-13] The intelligent nature of humans means that we need to trust in order to understand; trusting in science means that in time science will explain everything, whereas trusting in a religious sense (having faith) means believing that God will take care of everything. Historically, the development of medical treatment planning has been strongly influenced by this.[14,15] Nevertheless, over the last two centuries, science finally gained its autonomy from religion, and today the two areas of human endeavor are separate, to the obvious advantage of medicine.

An important aspect of the renaissance of medical science was the contribution scientists made to laying the anatomical foundations for the understanding of the cause-and-effect relationship that exists in the human body, and how the various parts of the body function and malfunction in relation to each other. This had profound implications for the development of clinical and surgical therapies. This cause-and-effect relationship can be seen as the initial basis for the current treatment planning rationale. Nevertheless, despite all efforts, ignorance about medicine among the general public was rife because society was disconnected and disorganized, and it was difficult and often impossible to teach and impart new medical knowledge and trends. At that time, medical treatment planning was largely unknown, and to the extent that it did exist, it was very primitive and poorly understood. Therefore, due to almost no true medical understanding, epidemics, traumas, infections, and cancers indiscriminately killed hundreds of millions of people. It took other two centuries before anatomy, physiology, and pathology became actual sciences, and the word 'treatment' became a medical term.

So, regardless of all the clever minds, poor transport and communication meant that people were isolated and led an insular way of life. Medicine itself was still largely based on old, inaccurate, and

often imaginary notions. Medical practitioners were on the whole pompously dressed, incapable ignoramuses, trying to describe nonexistent diseases with useless Latin words. Original paintings of this medical class show images of fantastic methods and therapies full of enemas, leeches, ointments, and draught potions that were invented and concocted to 'cure' all ailments and diseases.[4,16]

Only during the 17th and 18th centuries did physicists and chemists boost the curiosity of many people, so that people started to believe that they could follow in the footsteps of these scientists in all scientific matters, driven by their then brand-new practice of *scientific research methods* and the pursuit of *evidence of reality* theories. This indirectly contributed to the speeding up of the understanding of medical science and treatment planning. Indeed, probably without realizing it, physicists and chemists at that time were changing the way people thought about medical science.

It can therefore be said that medical treatment planning has its origins in scientists attempting to prove that formulas could explain all scientific elements and, indeed, the world. Over time, it became clear that *signs and symptoms* were useful and necessary to make a correct diagnosis of illness and disease. In fact, medical treatment planning is entirely based on scientific methodology and evidence. However, while physics, astronomy, mathematics, and biology were progressing at a rapid pace, scarce technologies and immature methods limited people's knowledge of the human body, no matter how curious they were. Also, the slow pace of life and very limited social contact meant that it was difficult to spread news, which created many problems.[4,16,17]

During the 19th century, medical scientists looking for scientific evidence and using the new scientific instruments of the time discovered more ways to heal and cure, which were perfected with time and passion, although many essential notions were lacking, and there was still no precise understanding of treatment planning.[13,18] Universities and medical and dental medical schools began to open and flourish in the USA and in other parts of the developed world, for example, the Baltimore College of Dental Surgery was founded in 1840, the Philadelphia College of Dental Surgery in 1842, Tufts Dental School in 1852, Harvard Dental School in 1867, and the University of Michigan in 1875. Passionate researchers and clinicians started to create the basis of actual medical and dental medical scientific treatments.[19] So, by the turn of the 20th century, official medical and dental medical science was starting to be oriented toward what we know today as 'assessed methodology.' The study of anatomy was acknowledged as the basis for understanding medicine, and investigations into the body's functions and malfunctions started to drive more organized and critical laboratory research and clinical practice.[18,20] Scientists' curiosity and eagerness for clarification drove them to begin to look for 'evidence' as the starting point. The worst of the religious influence on medicine was part of the past.

20th century to the present

While the 20th century gifted us with geniuses such as Albert Einstein (1879–1955), it also plagued us with two devastating world wars, which had a significant influence on the development of treatment planning in the west. About 20 million lives were lost in the First World War (1914–1918), and about 68 million in the Second World War (1939–1945). Apart from the death toll, war means all kinds of terrible injuries, physical and psychologic, created by all types of weapons. It means traumas, wounds, burns, disfigurements, and epidemics.

The world wars profoundly changed the lives of our grandparents and parents, and forced medical science to find surgical, clinical, and pharmacological solutions to address the sudden, terrible, and urgent traumas they caused. The wide range of injuries and infections, many of them never seen before, meant that the understanding about how to plan the treatment of patients accelerated, both during emergencies on the battlefields and in the clinic.

In addition, the 1918 influenza epidemic (known as the Spanish Flu), largely brought on by the un-

hygienic conditions of the First World War, left roughly 50 million dead worldwide. Therefore, the total death toll in the almost 50-year period spanning both world wars was about 125 million people, not to mention the millions more who were seriously injured in these wars and who died prematurely later on. On top of this, other local wars and epidemics followed, bringing the death toll to some 13% to 14% of the entire world population at that time.[21,22-24]

Due to these events, and thanks to the increased number of dedicated medical scientists and facilities, improved communication and media, and the growing body of scientific and medical knowledge that had been slowly accumulating over centuries, medical science made a great leap forward in the first part of the 20th century. The level of awareness and consciousness regarding medical treatment and its planning increased rapidly during that time, bringing a deeper understanding of the importance of knowledge about medical procedures and being well organized in the planning of treatment (this includes dental medicine and prosthodontic treatment planning, even though the latter is not always that well defined).[25-27]

Population growth is another important factor in the development of treatment planning. Over the last three millennia, the human population has increased from about 50 million to 7.5 billion people. Parallel to this is the increase in the number of scientists and thinkers who have dedicated their lives to solving medical problems, which has escalated the number of possibilities for furthering medical and dental medical science.[28,29] Inventions and discoveries that make possible the forward movement of science and medicine are not made so much by specific individuals as by the collective knowledge and awareness that accumulates over time.[30-34] This is known as 'collective intelligence,' which expands exponentially all the time, thereby increasing the possibility of more and more discoveries that lead to better medical understanding. For instance, about a century ago there would have been few, if any, physicists who properly understood Einstein's theories. Today, hundreds of thousands of students easily do, and thanks largely to the internet, their contributions to science are easily and quickly spread throughout the world. Just a century ago, only a few physicians knew what an antibiotic was, and thousands of people died of bacterial infections. Today, most people know about antibiotics and millions of people take them, often autonomously and without careful prescription (which has unfortunately also resulted in an alarming and increasing physiologic resistance to them).

This ties in with another important factor in the understanding of the development of treatment planning, which is communication and the media, particularly the internet and smart phones.[17,35-37] Since the two world wars (and therefore in less than a century), information about medical science has rapidly increased, and has been shared among millions of medical and dental professionals. This means that the panorama of clinical planning and treatment is continually changing and evolving.

'Hyper-science' and the future

When the famous physicist Niels Bohr (1885–1962) was asked to make predictions about the future, he said humorously: *"Predictions are very difficult, especially about the future."* Every small scientific step forward changes our understanding of how to plan and treat medical conditions. However, despite how technology today allows for easy online access for most people to medical research, data, literature, and information, human endeavor remains crucial and necessary.

Currently, data acquisition and processing speeds seem to depend on a number of disruptive 'innovation platforms' that cut across sectors and markets and converge on each other on the medical stage, such as:

1. 5G and 6G internet connections.
2. Micro and macro energy storage for industry, farming, transportation, cities, etc.
3. Plasma and quantum computers; liquid, nanomagnetic, and graphene transistors.

4. Artificial intelligence (AI), artificial narrow intelligence (ANI), artificial general intelligence (AGI), deep-learning software (DLS), and self-learning software (SLS).
5. Collaborative robotics and humanoids.
6. Computer-aided design/computer-aided manufacturing (CAD/CAM) and 3D printing.
7. DNA sequencing and CRISPR therapeutic genome editing.
8. Nanotechnologies.

'Hyper-science' (author's own word) seems an appropriate composite word for these revolutionary technologies and the current rapid growth of scientific knowledge. As never before, the progress of science is accelerating, and capabilities and possibilities are increasingly opening up. Which is why the medical progress indicators predict that medical and dental schools will structurally change in the near future under the pressure of digital innovations.[38-44]

A clear example of the above is the new, cheaper DNA sequencing and CRISPR genome editing that is enabling scientists to develop new types of diagnostic screens, tests, and therapies. Computational techniques are changing our schools and educational programs constantly, with the three-dimensional resources of virtual reality (VR) and augmented reality (AR) changing the way students and faculty interact, including the interaction with robots.[45-54] Nanotechnology is increasingly being used to treat patients. Predictions made on solid scientific bases foresee that, two or three decades from now, well-programmed super-intelligent ANI, and well-instructed human-dependent or independent AGI machines as well as AGI humanoid robotized digital doctors and caregivers will clinically treat patients suffering from an increasing variety of diseases and will also feature in the laboratory. These machines will be able to handle programmable and injectable chemotherapeutical nanorobots and nanocarriers. They will be much faster and, in many ways, more capable than humans to do the job of medical care providers.[25,41,55-58] We will refer to them with trust when we are ill or wounded.

Knowledge, consciousness, and indeed our entire way of living and working are being revolutionized. One only has to attend medical and dental medical meetings, conferences, and expos all over the world to see where the market is now and where it is heading, and how much money is involved. Human history has always demonstrated that whatever we are capable of imagining, we are capable of achieving. Digital science has come a long way, being completely free today of any religious constraints that might prevent it from progressing.

Currently, there is much hyper-scientific intelligent curiosity and imagination at work.[59] An exciting example is the newest IBM Watson Machine Learning, which harnesses machine learning and deep learning in a way that enables the management of an infinite amount of data. It gives flexible answers, insights, and possible solutions in many different fields of human endeavor, and is already useful to medical professionals in various fields of health care. For treatment planning, for instance, it can be used for collecting and reading scientific literature published in many languages. When asked about a specific disease or illness, it can promptly give one or more answers, propose a fitting diagnosis, and suggest various treatment options according to clinical facts, scientific evidence, and statistics. It can also design program interventions.[60]

However, despite all future AI digital capabilities and skills, the logic of treatment planning, with its basic and complex algorithms, will always constitute the common scientific foundation of medical, dental medical, and prosthodontic treatment and its planning.

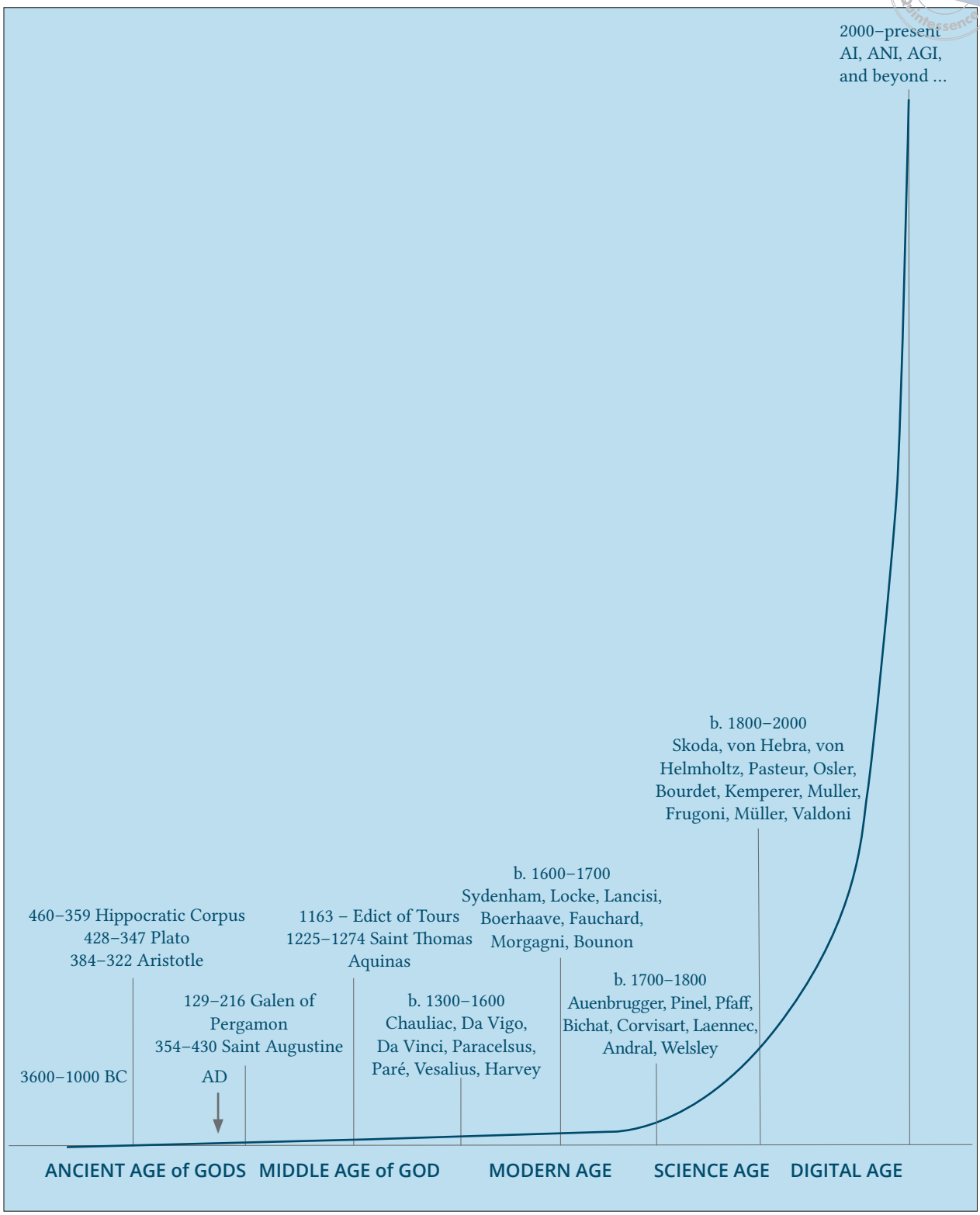

Fig 1-1 The birth and growth of medical examination, diagnosis, and treatment planning in western civilization. The first real scientific impulse occurred in 1500, with curiosity for the unknown and for medicine following until the end of 1700, when scientific evidence changed the schools and universities and gave birth to empirical knowledge and scientific research.

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