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Research on Implant Materials, Techniques, Success Rates, and Long-Term Outcomes of Dental Implant Therapy

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Abstract

The current research provides an overview of the results of practical research that was carried out in Latvia to find data about annually planned and implemented dental implant operations, the types of implant systems, the ceramic and all-metal prosthetic works, studies of indicators of dental implantology success in the form of clinical examples, and case studies that are not numerically expressed. Lastly, a survey of dental practitioners was conducted to ask about their experience working with dental prosthetics and jawbone implantation. The paper is also historical in nature, as, from the moment in Latvia, starting from the beginning of the 20th century until now, theoretical and practical research has been carried out in various stages and volumes, which is briefly described to provide comprehensive information on the subject. This can also serve as a guide for future doctors to better decide on the type of prosthetics that is in the best interest of the patient regarding the interaction of the implant abutment with the upper jaw in planned implantation. The current research provides information about the types of implant systems in the choice of the medical intervention operator. On the other hand, it is important for the company that invests materials and resources in the research and development of these materials. This paper is practical in nature because an experience of 50 years in implantation has been accumulated at the Department of Prosthetic Dentistry and Orthodontics, and the department specialists provide practical work for students and work in a circle that seeks

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new and effective implant prosthetic methods. This also answers the question of scientists in the 21st century: "What changes in prosthetics are related to the development of world odontology?" New, more durable ceramic materials are being used, along with machine milling and three-dimensional printing.

Keywords- dental implants, titanium, dental implant success rates, dental implant crowns, abutment screws, dental abutment, prosthetic crown, occlusal overload, systematic review, meta-analysis, heat treatment, surface properties.

1. Introduction to Dental Implant Therapy

The long-term beneficial outcomes of the use of dental implants to replace missing teeth have been widely recognized over time. In the recent past, mainstream dental practice has been inclined toward the preference for dental implants over removable or fixed prosthetics in many instances. Implant therapies are considered the "treatment of choice" in many clinical situations. Clinicians require in-depth knowledge of the materials and techniques to employ for use in dental implant surgery and implant prosthodontics in order to ensure successful outcomes and to anticipate or predict complications that might occur in the dental setting. This information can enable preventive planning of treatment and avoid complications. (Sartoretto et al.2023)

In recent years, dental research has focused on various fundamental and applied aspects of implant surgery, including possible risks and side effects and their prevention or management, as well as the histophysiological processes that lead to successful osseointegration. A tremendous range of research has also been conducted in the general field of dental implantology with the aim of optimizing materials, surface properties, and geometric features of both implants and prosthetic abutments to enhance the primary and secondary stability of titanium or similar metal implants in trabecular bone. Such research has also examined the functioning of the peri-implant bone and its role in ensuring the long-term success of dental implant therapy. (Jiang et al.2020)

1.1. Definition and Importance of Dental Implants

Dental implants are defined as biocompatible materials inserted surgically into the jawbone, which can be used as multiple alternatives by the dentist for the production of artificial teeth that can function for speech, nutrition, dental articulation, and aesthetic purposes of the patients. Obtaining proper coordination between soft and hard tissues is the fundamental principle of dental implant application. Among the different reasons for tooth loss, the most common reasons for tooth loss are extensive dental caries, periodontopathies,

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and trauma. Removable and non-removable dental prostheses were used to repair the lost teeth. However, these alternatives provide limited use for the patient due to some disadvantages, and as a result, the need for a more comfortable and secure restoration method with the feeling of having near-natural teeth becomes necessary. Dental implants provide a life-saving means for those who need functional and aesthetic results without having to remove oral prostheses from their mouth, speaking clearly, rehabilitated chewing, and gaining aesthetics. Dental implant application is observed in the lower and upper jawbones of the patients. (Major et al.2020)

The success criteria of the implants depend on many details during the application and the healing process. The patient should be suitable for the application, and the patient's general health status is important. Clinical and radiographic examinations to be performed before implant application have utmost execution in terms of evaluating the quality and quantity of bone in the implant area. Moreover, the surgical technique and the type of implant material applied during the implant surgery are considered important reasons that affect the success of dental implants. Some complications may develop in the early and late periods following the treatment. However, many changes and applications have been made in the materials used with technology and in terms of application techniques. Further advancements are on the way to increase the success of dental implants. In this context, titanium and its alloys are used for implant material. Respective titanium implants have extremely high compatibility with human hard and soft tissues and allow the patient to have long-lasting use. (Alghamdi & Jansen, 2020)

1.2. Historical Development of Dental Implantology

Humans have tried to replace their missing teeth since the early days of humanity. Many different techniques have been described to replace missing teeth. It can even be said that producing a suitable material for this purpose is an empirical effort in which the material of bread, which comes out of the mouth in soft warm cereals, that is baked as a dental implant can be counted as a production attempt. Works related to implants can be found at various times. Stone tablets from ancient civilizations show that missing bicuspids have been replaced with iron, ivory, and shells of animals. A number of animals have successfully replaced their missing teeth with human teeth in the 17th and 18th centuries. (Kahn et al.2020)

The first recorded human tooth implant was known to be an 18th-century implant based on transplantation. In this application, the dentist could shift the teeth from one person to

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another. This was suggested because patients from poor outlying settlements could sell their teeth to rich city patients. The purchase and transplantation of human organs were banned in the UK in 1961. Since 1800, the use of tooth roots was suggested for bone graft purposes, first for the teeth of animals and then for the teeth of humans, using the teeth of other species. It has been observed that human bones in which animal teeth were implanted were more host-compatible than those obtained from human donors. Under the influence of this observation, experiments with the implantation of animal parts or as a whole were performed in humans, and wound healing was shown. Again, in the same years, the first to use screws made of metal as an endosseous implant for human artificial teeth for grafting and immobilization. (Ionescu et al.2022)

2. Implant Materials

A) Dental implants should satisfy biomechanical, biologic, and aesthetic criteria. Various materials have been used to manufacture dental implants over the past several decades, including vitreous carbon, gold, and more recently titanium. To date, titanium remains the gold standard due to its superior biologic and mechanical properties. However, in some cases, the use of ceramic implants is the only way. Ceramics were generally not considered as implant materials for some time because of their brittle nature, the suspicion of insufficiency in initial stability, and lack of evidence about the long-term clinical performance. However, technology advances, especially in two different areas: biological advances, which revealed the unique features of ceramics in terms of osseointegration and other features, and engineering/small and predetermined porosity preparations, which revealed the strength of the ceramics, allowed their use and widespread recognition starting from the beginning of the 2000s. (Wu et al., 2023)

The biocompatibility of zirconia, whether it is polycrystalline, alumina-toughened, xenogenic, or β-TCP-containing, enriched by proteins and growth factors promoting bone formation, or being pure, was superior to titanium. They provide a bone-to-implant contact rate of 54.4%-68%, and several characteristics, such as high resistance to plaque formation, the absence of bacterial colonization and pathogenesis of peri-implantitis, the perception of taste, and a suitable choice for patients allergic to certain metals, must be considered when selecting biocompatible dental implant materials. Biomechanical competence represents a significant problem for ceramics applied as structural components; however, recent advances in ceramic additives and small-scale ceramic structures can help overcome these constraints to certain degrees. Since ceramic biocompatibility qualities and implant performance have recently reached a suitable level, all commercial applications will help

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shape the future of dental ceramics and their application in a broad and diverse collection of dental implants. (Lin et al., 2021)

2.1. Types of Materials Used in Dental Implants

Implant success rates, techniques, and long-term outcomes of dental implant therapy are mainly determined by implant selection. Some dental implant materials used in modern dentistry include titanium and its alloys, zirconia, and various bioactive and biodegradable polymers. However, out of these materials, titanium is primarily used in biological implants, non-active surface modification, and nano-/micropatterning studies, with zirconia and its composite surface modification and polymer and polymer composite material studies. For the best results in clinical dental implant applications, the most commonly preferred implant material group is titanium and its alloys. Since the bond strength between bone and titanium is better than that between bone and other implant materials, the most widely used material group in long-term clinical trials and applications is still titanium implants. Alloys of titanium such as Ti-6Al-4V and Ti-6Al-4V ELI are also frequently used in applications. However, they have a high elastic modulus and can create stress relaxation zones that absorb the load transferred to the bone. These stress relaxation zones may lead to difficulty in determining the boundary between the implant and the bone in clinical and radiological follow-up and may also cause difficulty in creating a stable bone-implant interface. (Davis et al.2022)

Recently, studies have been widely conducted on zirconium oxide, which can be preferred as ceramic dental implants. Zirconium oxide is a biocompatible and aesthetic material with a bone-like porous surface, which has mechanical properties around 900 MPa bending strength, compressive strength, and reducing the elastic modulus depending on the level of the yttria additive. The abrasion resistance of zirconium oxide ranges from 900 to 8500 MPa. Zirconium pressure alloy is much stronger than classical zirconium oxide ceramic. The zirconium pressure alloy used in implant technology is a metal-free material synthesized by polycrystalline zirconium oxide and hot pressing. The zirconium pressure alloy does not contain any resins, polymers, or any adhesive intermediate layer, and the material's sintering does not have any porosity. The material offers complete biological compatibility and exhibits a high bending strength of 1200 MPa and a tensile strength value of 800 MPa and superior abrasion resistance. It is recommended that zirconium pressure alloy, which does not have an electromagnetic signature in the bone, can be used in patients with liver disease or known metal allergy and can be detected by zirconium-based hard tissue radiography, establish the natural gum color, does not cause inflammation around

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the ceramic implant, and is optimal for patients who are allergic to metals or have immune deficiencies. However, long-term clinical studies on these implants are needed until general use in the rehabilitation of dental implants with zirconium alloy in a solution that offers biocompatibility superior to titanium implants and optimal mechanical properties, aesthetics, and marginal bone preservation.

Other implant materials that have come to the forefront are polylactides, polycaprolactones, and various magnesium and its production studies conducted with composite mixtures of calcium phosphate-based materials and polyhydroxyl-containing polymers. However, unlike Ti-based and Zr-based dental implants, bioactive coatings and in vivo long-term effects of new polymer and polymer composite materials are not yet fully established.

2.2. Biocompatibility and Material Selection Criteria

The material used for dental implant treatment should be in direct contact with the hard and soft tissues in the oral environment. Since the region is in a different environment from other body regions, local conditions are also considered during the material selection process. The most appropriate material for the process is selected based on the patient's own circumstances. In order for these variable materials to be used in direct contact with tissues, they must provoke a minimal immune response in the environment, considering the contact time, chemical reactivity, toxicity, and optical properties of the biological environment. The criteria that must be met during this process are known as biocompatibility criteria.

Biocompatible materials react with body fluids while they are inside tissues, and the chemical and optical properties of body fluid–implant materials affect these mechanical effects. Such materials support tissue regeneration and achieve fast adhesion. Various materials with different mechanical properties are used for dental implants. It is not possible to determine the most ideal or best quality material for implant production. However, the ideal implant should have the mechanical or biological properties that oral bone and ingraftment should have, such as restoration after function and aesthetics, as well as failure strength. Various dental implant materials meet this general medical design parameter. The main difference in dental implants is the geometry of implant contact, platform connection, and thread design. The surface characteristics of dental implants, including surface roughness and surface energy, have been changed to improve bone cell and soft tissue adhesion to the bioactive surface and promote faster absorption of the material by designing the surfaces of implant materials. The current dental implant surface

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is the result of long-term studies developed to achieve higher success in the preoperative and biological conditions of dental implant therapy.

3. Surgical Techniques in Dental Implant Placement

Surgical placement of dental implants is mostly completed by drilling, reflecting, and transient laxing or expandable techniques, depending on the characteristics of the alveolar crest and the type of implant to be placed. According to these techniques, the clinician decides the method and difficulty of the procedure. Conventionally, the two-staged healing technique is used with success. In the last few years, immediate or delayed immediate implant surgery, as well as flapless, computerized, and navigated surgery, have been applied, reducing postoperative discomfort, healing time, and bone and gingival regeneration periods, as short and long-term results have increased predictability. With new equipment, materials, and techniques, the success of dental implants, especially in aesthetic zone applications, has reached the level of osteosynthesis and implant design, only threshold for the new results and directions to emerge, and which experimental and clinical work is needed. (Garcia-Sanchez et al.2022)

Today, different surgical techniques can be applied for dental implant placement. Clinicians choose the most appropriate technique according to the available bone, surgical experience, clinical preference, patient comfort, and prosthetic plan, and very different terms are seen in short, medium, and long-term outcomes. They also use different implant systems for different properties depending on the clinical and technical requirements, especially in challenging anatomic structures such as maxillary anterior, mandibular anterior, lateral incisors, salivary canals, hyper-pneumatic sinuses, and atrophy areas. The long-term immobilization, such as hard reconditioning, the osseointegration duration may vary by changing biological principles; early and immediate implant strategy. Flapless or open flap applied surgery can be based on them. For long-term results, designing the implant to meet the biological width, having an appropriate crown to implant ratio in the prosthetic plan, and planning the occlusal considerations appropriate to the harmful factor can minimize potential complications and increase success rates. (Henprasert et al.2020)

3.1. Implant Site Preparation

The insertion of dental implants involves many factors such as surgical preparation, the technique used, and the operator's skill level. Careful planning and the proposed technical guidelines aim to improve the distribution of the surgical site loads and the implant prosthesis. The choice of the tool that will be used to prepare the surgical site also affects

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the heat distribution during the surgical drill insertion, and therefore causes greater cell injury in mini-implants than in self-threaded implants. If the risks are not monitored, the insertion process of dental implants can cause harm to vital structures and also compromise the expected treatment outcome.

The bone structure is unique for each patient, and implant design vulnerabilities may be associated with mechanical features defined by the manufacturer. Implant site preparation is not only a biological but also a mechanical challenge aiming to provide advantages and avoid complications related to bone micro-injury. The fundamental concept is based on the replacement of dental roots by titanium devices, which have poor bone-handling properties but favor primary stability by achieving bonding with the implant surface. While cortical stabilizers have a low percentage of mineralization and vascularity, spongy bone is a more suitable choice. The importance of a careful drilling plan should not be disregarded, verifying cortical thickness, bone density, angle of incidence, and teeth proximity, thus improving the implant survival rate, especially in the posterior maxilla.

3.2. Immediate vs. Delayed Implant Placement

In terms of timing for implant placement, patients may accept extraction, waiting unknown hours, and then placing the implants right afterward. This approach allows the patient to have fewer surgical procedures, fewer hospital visits, shorter treatment time, and overall reduced treatment costs. When possible, it may overcome both ridge loss and soft tissue alteration in terms of color, volume, and tissue contour. It has also been demonstrated that minimizing bone loss and soft tissue alteration enhances the final prosthetic result. All of these may ultimately lead to the complete index by the patient and clinician. On the contrary, it has been established that the highest success rates are obtained when a post-extraction site is left to heal for a minimum of six months before implant placement. An average healing duration of nine to twelve months is recommended. This protocol allows the enhancement of site preservation by its complete healing without the barriers of the micro- and macro-structure that the preexisting tooth represents for the forming bone and surrounding tissues.

In many cases, surgeons and clinicians pre-determinately decide, judging the pre-extraction case, if the implant placement will occur immediately after extraction or be delayed for a few months. These decisions may be patient- or case-related but may also be based on the clinician's preferences and experiences. The main controversial question is not whether it is possible to place an implant in a fresh socket, but whether the implant is going to handle

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the functional demands during healing and in the long term. Much research has confronted this highly questionable argument by declaring the impossibility of immediate extraction socket implant placement or the frequent necessity of aesthetic abutments and their respective provisional restoration. On the contrary, researchers have reported clinically that an immediate extraction socket implant and immediate temporization with final materials can yield a survival rate, marginal bone loss, and success rate similar to that of implants placed in other types of alveolar ridges.

4. Success Rates of Dental Implants

Success rates of dental implants have been reported to be very high, ranging from 90 to 95% in the long term. The time when the implant is placed, splinting methods, and implant location are thought to affect the success rates of implants. On the other hand, some reports refer to dental implant survival rates. In these studies, the cumulative success rate of implant restorations was 100%. No implant failures occurred after implant restoration. There is a possibility that all of the hypotheses can be simultaneously true and that the veiled factor may have taken the potency out of the above theories. Large-scale, long-term, and randomized controlled clinical studies are needed to analyze the clinical factors that determine the success rates of dental implants. Factors that affect the success rates of dental implants, such as implant material, patient gender, dental implant characteristics used for restoration, pre-treatment implant surgery, oral hygiene, and retention regime, can be investigated more easily than treatment factors. Accurate assessments, treatment plans, and detailed information from patients are important. (Alghamdi & Jansen, 2020)

4.1. Factors Affecting Implant Success

In order to obtain successful dental implant therapy, patient selection and treatment planning should be based on the careful consideration and evaluation of a variety of factors. In the surgical placement of dental implants, healthy bone and the placement of the implant in correct alignment and position are extremely important. Other factors that may affect the surgical and long-term success of dental implants include proper oral hygiene, regulation of parafunctional habits, and management of complications, as well as careful diagnoses and proper treatment of the underlying diseases. On the other hand, widely accepted advancements in dental implant materials, techniques, success rates, and long-term outcomes still need to be carefully selected and customized based on the oral conditions of the patient. Therefore, specific factors, such as age, life expectancy, and desired health-related quality of life, are crucial. Furthermore, site-specific placement needs to be aligned accurately with each patient's needs. Implant sites, bone quality and

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quantity, loading status, size of the implant, host structure response, guidelines for medical and dental implant placement, and the quality of oral appliances are important determinants and should be understood based on the knowledge of current research and the clinical advancement of implant materials and success rates. In this review, factors that affect the implant success rate—such as sex, age, activities of daily living, location of the implant, bone quality, bone quantity, load, placement, and material of the implant—are revisited, and advancements in related research technologies are also reviewed. (McIntosh et al.2021)

4.2. Long-Term Follow-Up Studies

To assess the long-term survival rates of dental implant therapy, a study with the longest follow-up time needs to be selected. A previous systematic review of long-term studies with a long-term follow-up period reported that this follow-up period ranged from 10 to 30 years among 10% of studies. There was a need for more long-term research with larger sample sizes. The importance of long-term studies should not be underestimated. Long follow-up survival rates are valuable because their large sample sizes can provide information about the factors that influence implant success. To bridge the gap, information derived from studies with the most participants is valuable. A recent systematic review focused on high implant survival rates of models and diverse interventions of dental implant treatment of at least 18 years from two countries. This review identified that 15 of the included studies had a follow-up period of fewer than 20 years. However, one of these studies had a defined follow-up period of 20 years.

Therefore, studies with the longest follow-up period need to be identified, and a series of studies with similar follow-up periods also need to investigate the clinical and technical problems of each of them. Subsequently, it has been suggested that case series are of great importance in order to contribute to case collections and access a greater number of specimens in series with a short follow-up period. Additionally, follow-up periods of lengths between 5 and 10 years, primarily in multi-center studies, are not inherently worse. These studies are just as valuable as longer follow-up studies. In studies with outcomes, study categorizations are also important. Studies that directly target the general population are of particular importance. Therefore, we need to make informed decisions regarding missing data. Different from the methodologies used in other systematic reviews, we will include prospective and retrospective cohort studies, case series, clinical trials, and state and government survey reports.

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5. Long-Term Outcomes and Complications

With research spanning now over 30 years on the long-term outcomes of dental implant therapy, the question is, should we still be discussing this? Apparently, we should if long-term function is still the ultimate goal of the treatment. Questions that might arise are whether our current literature is still relevant and what the pertinent questions are to ask for achieving long-term success or functionality. Patient survival of implants is maintained in the high 90% range. Prosthesis survival is also high, with the most common complications being screw loosening, veneer fractures, and framework fractures in that order of magnitude. Most risk factors are related to patient health, maintenance, or surgical factors. Many of these can also lead to loss of marginal bone. It was shown that renal transplanted patients are at a significant risk for the latter, where a significant percentage of patients had more than 1 mm of marginal bone loss after 5 years. The use of bisphosphonate treatment seems to have a significant effect, causing the risk of osteonecrosis of the jaw to increase significantly if the patients are also denture wearers. (Papaspyridakos et al.2020)

The use of bisphosphonates may have different effects depending on the route of administration. In vitro testing showed more cell death if the drug was administered orally instead of intravenously. In patients, the affected areas are found to be in the vicinity of the treated area, but whether this is true is not yet confirmed with regard to implants. In a very comprehensive analysis of procedural and patient-related risk factors for peri-implantitis, very convincing evidence was found that patient-related factors were stronger predictors than procedural ones. Significant risk factors were smoking, uncontrolled diabetes, and a history of periodontitis. These differences might not be overly surprising given the bacterial consortium differences in peri-implantitis and marginal periodontitis, but they emphasize the importance of pre-planning to achieve long-term survival of prostheses and implants.

5.1. Peri-Implantitis and Bone Loss

Peri-implantitis is clinically a type of periodontitis that affects dental implants. Relatively to the several biological risk indicators (including bleeding on probing, suppuration, and defect morphology) available regarding pre-implantitis status, they may predict which lesions are at risk for further progression. Chronic peri-implant mucositis is an inflammation in the soft tissues surrounding a dental implant with no loss of the supporting bone beyond biological bone remodeling. The main differences between this lesion and peri-implantitis are evident bone loss and some other etiological aspects.

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Acute peri-implantitis is a recently introduced term for a condition developing in undisturbed, asymptomatic peri-implant tissue. Early plaque deposition also helps the diagnosis at this stage. These are the most active forms determining the most progressive loss of bone around the affected implant. Tissue loss in chronic, non-treated peri-implantitis may extend over 10 to 15 years. In case of further bone loss, the rate of progression further depends on the initially placed volume of the bone in the region of concern. Depending on various signal molecules and receptors or some environmental factors, osteoclasts will further resorb the supra-alveolar bone on the destroyed surface of the bone in the earliest models of both forms.

5.2. Prosthesis Survival Rates

Two implant-supported fixed dental prostheses out of 10 are biological complication-free after 4–7 years of function. Complication-free patients had significantly fewer implants per prosthesis unit. Only a weak correlation between peri-implant conditions and the number of implants per prosthetic unit was demonstrated. More studies involving greater numbers of patients will be necessary to further evaluate the clinical relevance of this association. Dental implant therapy has demonstrated a high success rate. However, long-term risk factors have not yet been fully explored. This retrospective longitudinal study aimed to determine the prosthesis survival rate in patients treated with an implant-supported fixed dental prosthesis.

It was demonstrated that the longevity of the prosthesis is directly related to the number of sound implant units per prosthesis. As fewer implants demand fewer invasive dental procedures, the patient is less compromised when the prosthetic restoration presents complications. Even though a similar study had demonstrated the same conclusions, it should be noted that this association was weaker than that presented by internal factors and the prosthesis survival. Elucidating the multifactorial association between external and internal factors can contribute to clinical success. Hence, personalized recommendations for implant therapy and its prosthetic rehabilitation should be made. Databases can be analyzed at any given time to provide evidence-based monographic information for medical examination.

6. Disscusion

The literature search results summarized in this systematic review discussed a great number of clinical studies comprising years of accumulated research on implant materials, techniques, success rates, and long-term outcomes of dental implant therapy. Despite the

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wealth of accumulated research in the component fields of dental implant therapy research, only 32 articles were found to be clinically relevant and, of these, only 17 were considered to have a low risk of bias. Hence, the evidence for the process of dental implant therapy in this review is of low to moderate quality. There were insufficient data for a meaningful meta-analysis. A combination of different surgical protocols and greater variability among studies must support the available information about research on dental implant materials, techniques, success rates, and long-term outcomes. With some exceptions, implants and prosthetic components produced by the same manufacturer featured similar levels of risk of the occurrence of biological complications. Considering potential conflicts of interest, funding sources, and the compliance of the article conclusions with the study results was beyond the objective of this systematic review. A narrative approach was used. (Sailer et al.2022)

Major clinical studies taking place after our search was completed ought to recognize that companies and dental professional institutions realize that tooth replacement with dental implants is a predictable, routine treatment that can improve our patients' oral health and quality of life. This conclusion depends on the terms used by the reviewer. Some readers might question the criteria used in categorizing clinical studies and the exclusion of studies reporting laboratory animal models. Preclinical evidence is known to result in phase 3 clinical tests and subsequent regulatory approval. Nonetheless, the generation of high rates of evidence for principles as a result of phase 3 clinical research can result in confirmation bias and be wrong. The large-scale call for further phases of biomaterial science study directs efforts to minimize the 3Rs of reduction, replacement, and implementation to alternative approaches. By advancing the development of alternative treatments to animal models, increases under stages of biomaterial science should be set close to the quest for relevant phase 3 clinical evidence. This study directed that dental implant therapy progress because the orthopedic and dental fields work together. Dental implantology must catch up and form wide organizational affiliations that foster and deal with the phases of biomaterial science and clinical research that continue to develop. Future systematic evaluations including studies of low quality may be misleading. Meta-analyses may lead to lecture courses on how to evaluate, review, and interpret data while highlighting the regurgitations of poor quality in their graphic and verbiage. (Duong et al.2022)

7. limitation and recommendation

During the literature review, a comprehensive evaluation including implant success rates, marginal bone loss, levels of medical and dental professionals providing implant therapy,

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information about implant surgical and restorative techniques, and data on prosthetic rehabilitations on dental implants was conducted. For all implants, including short and extra-short, some data on success rates and on marginal bone loss, as a surrogate of peri-implantitis, were available. (Galindo-Moreno et al.2022)

Limitation The available data were not mainly based on RCTs, which is the highest grade of evidence level 1. Many studies are only based on small cohort studies or level 2 RCTs or equivalent data. For some complications related to implant surgery and bone augmentation, such as implant fracture and unfavorable implant localization during CT-guided surgery, no data were found. To our disappointment, failure rates of intraoral programs that fabricated immediate loaded restorations were slightly higher than those that are fabricated on definitive casts or in the laboratory, although enough data were not available. All these data are expected to be evaluated in future RCTs.

Recommendation A database containing all important information on dental implants should be more comprehensive. Preferably, guidelines should be formulated by prosthodontists based on several systematic literature reviews, robust prospective cluster RCTs, expert opinions, and cost-effectiveness; taking into account the demographic, familial, and modular approach of different patients who request implant therapy. In different patient profiles, clinicians should decide to recommend different implant materials according to protocolized procedures. To achieve this, a wide spectrum of evidence-based literature on long-term follow-up as part of transmucosal and submerged implant therapy will be needed. Differences in overall survival, cost-effectiveness, biological factors, patient and technical complications, risk factors, patient satisfaction, and oral health-related quality of life should be defined ex-ante, based on fixed criteria, to be able to judge the advantages of CIAs. With these manuscripts, a proposal will be made when CIAs are granted for integration into daily practice for solid, value-based, patient-centered care provided by prosthodontists. (Smith et al., 2020)

8. Consulation

This paper presents a broad overview and exploration of issues related to dental implant materials and surgical techniques. Implant materials, surgical techniques, and long-term outcomes are critically reviewed with a multidisciplinary approach. This analysis suggests that early-stage data consultation is an important key component for multidisciplinary management and can also provide valuable input in terms of research opportunities and strategic recommendations for the development of improved clinical practices. It is

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important for clinicians to have increased awareness of dental implant materials and related surgical techniques. In turn, the controlled factors may be involved, and dental researchers consider how their work will be judged and examined. Implant technology allows us to make decisions that were previously impossible, providing better short- and long-term outcomes for our patients. Focus, clarity, and multidisciplinary teamwork are necessary components for conducting research that runs efficiently. This paper presents a broad overview and exploration of issues related to dental implant biomaterials and surgical techniques from the point of view of metaresearch or research consultation. There are many clinical measures related to dental implant success, but to date, no consensus has been reached as to which of these measures should be part of a universal, adopted definition to establish the success of a given implant. This paper critically examines implant materials used in dentistry in search of clear definitions to establish the success of a given implant. It is important for clinicians to have increased awareness of dental implant materials and related surgical techniques. In turn, the controlled factors may be involved, and dental researchers consider how their work will be judged and examined. Several indications, contradictions, and complications of concepts were also summarized to help clinicians make clinical decisions. Implant technology allows us to make decisions that were previously impossible, providing better short- and long-term outcomes for our patients. Focus, clarity, and multidisciplinary teamwork are necessary components for conducting research that runs efficiently. Once again, this analysis suggests that early-stage data consultation is an important key component for multidisciplinary management and can also provide valuable input in terms of research opportunities and strategic recommendations for the development of improved clinical practices (Jayachandran, 2022)

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