

A Systematic Review to Support Assisted Dental Implant Process

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Abstract. Nowadays it is possible to identify an interaction between health and engineering areas in order to provide better patient care. In dental implant studies, an interaction between areas makes the success of the surgery not dependent exclusively on the experience of the dental surgeon. Providing subsidies to aid decision-making makes the procedure more efficient and more successful. Thus, the aim of this paper is to present a systematic review focusing on the Support for Decision Making in the Assisted Dental Implant Process. The methodology to accomplish this work initiate with a systematic review. It was search in the literature, in different available databases from CAPES journals portal, the content of the articles to identify the state-of-the-art, defining the keywords of this search, moreover the categorization in primary and secondary keywords, definition of parameters, search with databases CAPES journals portal, selection of articles, reading and analysis of content, definition of inclusion and exclusion methods, identification of work process milestones, analyze contributions and limitations of each author. This systematic review demonstrates keywords in the process of dental implants, that is, works that stand out, fulfilling the requirements of this research. Therefore, by finding the state of the art, it is possible to identify important points in the dental implant process by identifying new research and development opportunities. As an opportunity for future works, it is possible to analyze the bibliographic references, identifying the key authors and seeking their contributions to the decision support process of the surgeon.

Keywords. Systematic Review, Dental Implant, Product Engineering, Decision Support.

Introduction

Currently, the procedure for performing dental implants is complex and requires correct decisions be of broad responsibility, considering a good planning and the surgeon experience. In this way, put together dentary area and engineering questions can bring benefits to patients, significantly improving the quality of life of people who, considering the most varied causes, have lost their teeth during their lives. Supporting the surgeon's decision-making makes the chances of implant rejection mitigated and improve the existing alternatives, considering the best choices.

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With the increasing relationship between the engineering and health, it is possible to offer better results to the patient. With the speed at which technology advances, the software industry provides increasingly close simulations of the conditions found in the human body. In medicine, it is possible to find engineering applications aided by computers (CAE), like in the processes of surgeries and mapping the systems of the patient. According to [1], to make the diagnosis process more precise and safe, integration between health and engineering is essential, promoting the increasing accuracy of medical devices.

In the area of dentistry it is very common for decisions to be based on the experience of the surgeon, but with the advancement of information, it is possible to combine the experience of the surgeon with automated systems in order to find the best solution for the patient. In this way, guarantee the interconnection between the engineering and dentistry areas to plan the dental implants could minimize errors, helping in the surgical process.

Globalization has had a significant impact on the transformation of the performance of the most diverse areas of engineering, including in the interaction with other areas, such as the interactions between engineering and health areas. This globalization of markets and technological development give consumers quick access to information and make them more demanding. According to [2], there are very evident transformations towards information technology and the flexibility of information, highlighting not only in industrialized countries but also in developing nations, thus creating the "information society" or "knowledge society" that have come to replace the term "post-industrial society".

In the engineering sector, more specifically in the product development sector, globalization makes the market more and more competitive and the interactions of the areas are more evident. Developing a particular product involves the team's ability to find the best solution to the customer's problem by meeting them at a competitive cost. According to [3], the success of the product is aimed at the company identify the needs of the customers and immediately develop products in order to serve them. This product trajectory is born by identifying the problem that the customer is facing and consequently which solution will be addressed.

People are based on the decisions they make throughout life, at all times it is necessary to choose, to decide which way to go. According to [4], life is surrounded by decision-making, but this process is intrinsically complex and controversial, not choosing between actions but also points of view and way of evaluating actions, considering a multitude of factors directly and indirectly related to the decision to take.

Just as in the area of product development, supporting a better decision to make is increasingly embedded in working conditions. Take a direct correction of the knowledge covered, consistency and most of the time, wide experience.

In order to make a correct decision, it is essential to evaluate the greatest number of possible variables and consequently to arrive closer to what would happen if each decision was taken. According to [5], to solve a problem there is a need to choose directly or indirectly, at least one of several different alternatives. Today, making these decisions is more difficult than in the past, because information changes much faster than in the past. Engineering along with the area of product development and information systems can help support decision making, leaving the burden not only under human responsibility. Inserting the concepts to better support the professional's decision can generate time, money and decrease the chances of error.

Due to the many different causes, including increasing the longevity of the population, many people end up losing their teeth throughout their lives. The combination of the product development and dentistry areas can reduce the complexity of dental implant procedures, as the best decision-making requirements are based on the dental surgeon's planning and experience.

There are currently many types of dental implants and this ends up making it difficult for the dental surgeon to decide, he ends up having the images of computerized tomography, the options available in the market and his experience for the best decision.

There are already studies focused on the image revision process, analysis of the dimensions and structure of the tooth, measurement and planning of the process and simulation algorithms, which can be extended as analyzes of type of patient or dental implant operations. theme. Through the systematic review, with the search for periodicals and the execution of filters, as the inclusion and exclusion parameter defining landmark studies.

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There are already studies focused on this topic or which deal with image processing, analysis of tooth dimensions and structure, process measurement and planning, and simulation algorithms, which can be extended as analyzes of the type of patient or multiple dental implant operations that this work can contribute to this theme. Through the systematic review, with the search for periodicals and the execution of filters, as the inclusion and exclusion parameter defining landmark studies this article aims to find important bibliographic references for the dental implants process.

1. Methodology

1.1. Systematic Review

The systematic review was carried out in three stages, where the first one consists in choosing the parameters to be analyzed, then choosing the key words, analyzing them to verify similar words aiming to reduce them and to realize the pair junction. In the second stage, the articles were searched in the databases, analyzing the bond with the research object and recording relevant information, saving the files in chronological order. In the third stage, the selection of the articles is started, with a title and abstract reading to make a first selection, then read the selected articles to perform the content analysis. Content analyzes were performed through reading and observation to generate knowledge.

1.2. Search and Selection

This research is substantiated so that the information systems together with the engineering can offer sufficient elements to the decision making regarding the definitions of dental implants.

Based on the search parameters, thirty (30) keywords were defined to start the search. To define the key words, it was chosen words that were linked with the research theme.

By analyzing these key words, it was possible to verify that these could be reduced and thus improve the search parameters by refining the process and searching for the best search conditions. As a requirement, words with the same meaning were chosen and refined the search in order to guarantee quality in the research process and that were focused on the research theme.

After defining these keywords, the search was started. This was carried out with research in the Brazilian scientific database (Periodicals CAPES), which has 532 databases including Emerald Insight, Elsevier, Science Direct, among others. The journals were searched together in two words at a time, refined in pairs and only the English publications were taken into account. These combinations generated a very wide of articles and these did not necessarily attend the focus of the study. Aiming to refine the research, it was defined that primary and secondary words would be stipulated, and in doing so, the research would be more refined.

From this definition were made the junction to start the research in the database, according to figure 1.

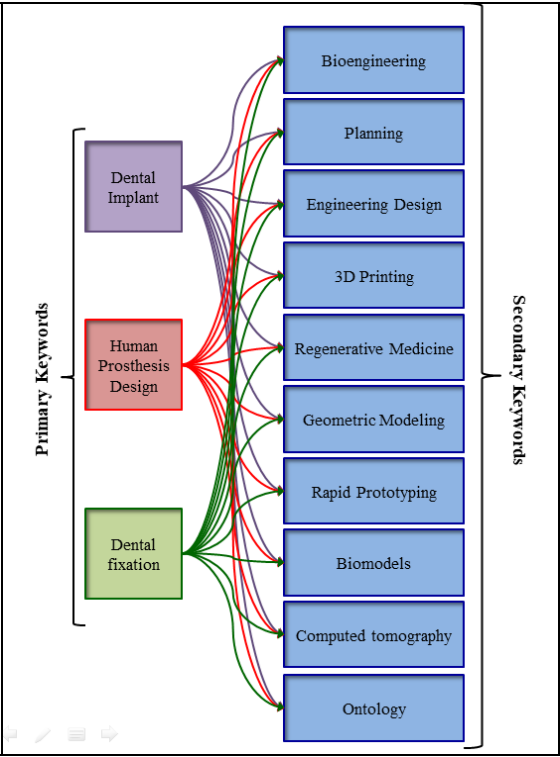


Figure 1. Keyword merge system.

From this point on, the researches in the Brazilian scientific database (CAPES journals) were restarted. In this stage, the relevant bibliographical references were collected according to the key words, articles in English peer reviewed.

The titles and abstracts of the articles made available from the database were read in order to begin the search refinement to find the articles referring to the theme of this research.

In this analysis, inclusion and exclusion factors were used to select the articles according to frame 1.

Table 1. Inclusion and exclusion factors.

Inclusion Factors	Exclusion Factors
<ul style="list-style-type: none"> • Title with subjects related to the key words or subject of study; • Provide information relevant to the surgical planning of the dental implant; • Provide information on the systematic review of the literature on dental procedures. 	<ul style="list-style-type: none"> • No information related to dental implants; • Provide information related exclusively to medical procedures.

The articles were saved, cataloged and their information registered in an excel[®] spreadsheet to facilitate the analyzes. The files were saved in format and pdf and the combination of the keyword, total number of articles that resulted the search, year of publication, ISSN, DOI, Authors, Title, Impact factor, QUALIS, JCR (qualification in several research areas), SJR and average publication time was done.

After this first analysis, 176 articles were obtained, then the repeated ones were removed and 152 articles were left to carry out the content analysis.

1.3. Content Analysis

Critically analyzing the content causes the state of the art to be found, that is, it is possible to identify the best in the world focused on the research theme. Therefore, the articles were started reading in order to identify what each article addresses their contributions to the research and its limitations.

In this reading, articles were identified which were outside the scope of this research, that is, the same criteria already defined in Table 1 were used. After this analysis, there were 139 articles.

At this point, criteria were created based on the impact factor, qualis indicator and index indicator of each magazine and withdrawn the items that presented:

- Impact Factor < 1;
- Scimago <1;
- Qualis B2 or lower.

In this item, they reached 45 articles.

Analyzing these 45 articles, the axes of analysis were defined and the criteria that will be used in each axis:

- Integrated product development;
- Systems to support integrated decision in the dental area;
- Ontology;
- Systematic literature review.

Within the field of integrated product development, there are a few issues to be analyzed in order to achieve the state of the art and filter the articles that most represent for this research, analyzing integrated product development, decision support,

interaction between the areas of engineering and dentistry and systematic literature review.

1.4. Discussion of results

After the articles were categorized, the articles that did not clearly show the objective of the research were removed and 17 articles were kept. Their contributions and limitations are demonstrated in Table 2 in chronological order.

Table 2. Content Analysis

Year	References /Authors	Title	Contributions	Limitations
2000	[6] / Werner, A; Lechniak, Z; Skalski, K; Kedzior, K.	Design and manufacture of anatomical hip joint endo prostheses using CAD/CAM systems	Discusses support for decision making	The article specifies the manufacture of the implant
2005	[7] / Heckmann, SM; Karl, M; Wichmann, MG; Winter, W; Graef, F; Taylor, TD.	Loading of bone surrounding implants through three-unit fixed partial denture fixation: a finite-element analysis based on in vitro and in vivo strain measurements	Demonstrates the degree of stress that occurs in the bone around the implants.	There is no basis for long-term questions.
2009	[8] / Fleischmannova, J; Matalova, E; Sharpe, PT; Misek, I; Radlanski, RJ.	Formation of the Tooth-Bone Interface	The understanding by the dentist of the relation between the teeth and the alveolar bone and the absorption patterns	The understanding by the dentist of the relation between the teeth and the alveolar bone and the absorption patterns
2009	[9] / Lin, D; Li, Q; Li, W; Duckmanton, N; Swain, M.	Mandibular bone remodeling induced by dental implant	Algorithm that assists the dentist in decision making. Image processing	No modeling of bone loss hampering this point of the surgeon's analysis;
2010	[10] / Chen, XJ; Yuan, JB; Wang, CT; Huang, YL; Kang, L.	Modular Preoperative Planning Software for Computer-Aided Oral Implantology and the Application of a Novel Stereolithographic Template: A Pilot Study	Model, use of CAD / CAM for implant simulation, development, surgical planning software and multiple implants.	Software cannot be used on Windows, Linux and MAC platforms
2010	[11] / Ribeiro-Rotta, RF; Lindh, C; Pereira, AC; Rohlin, M.	Ambiguity in bone tissue characteristics as presented in studies on dental implant planning and placement: a systematic review	Systematic Review of Literature; Descriptions of the bone tissue characteristics used before or during dental implant placement were searched and categorized.	The systematic review contemplates only the characteristics of the patient's bone, this information being important for the surgeon, but not enough for this research
2010	[12] / Bardyn, T; Gedet, P; Hallermann, W; Buchler, P.	Prediction of dental implant torque with a fast and automatic finite element analysis: a pilot study	Decision Support of the Surgeon	Finite Element Analysis
2011	[13] / Naitoh, M; Hayashi, H; Tsukamoto, N; Arij, E.	Labial bone assessment surrounding dental implant using cone-beam computed tomography: an in vitro study	Analysis of computed tomography images; Procedure for performing dental surgery.	Material engineering analysis
2011	[14] / Wakimoto, M; Matsumura,	Bone quality and quantity of the anterior maxillary	Analysis and processing of	Contemplate only the patient's bony

	T; Ueno, T; Mizukawa, N; Yanagi, Y; Iida, S	trabecular bone in dental implant sites	images. Relevant information the bony conditions that help the surgeon in his decision	characteristics
2012	[15] / Kim, G; Lee, J; Seo, J; Lee, W; Shin, Y-G; Kim, B.	Automatic Teeth Axes Calculation for Well-Aligned Teeth Using Cost Profile Analysis Along Teeth Center Arch	Method to identify individual teeth with axes accurately, demonstrating that they can give dentists substantial assistance during dental surgery.	It may not work successfully for non-defective teeth such as overlapping or missing teeth, you need studies for multiple dental implants.
2012	[16] / Streckbein, P.; Streckbein, R.G; Wilbrand, J.F.; Malik, C.Y.; Schaaf, H.; Howaldt, H.P.; Flach, M.	Non-linear 3D Evaluation of Different Oral Implant-Abutment Connections	Junction of health and engineering areas	Analysis of tension and force in implants
2012	[17] / Neves, FS; Vasconcelos, TV; Campos, PSF; Haiter-Neto, F; Freitas, DQ.	Influence of scan mode (180 degrees/360 degrees) of the cone beam computed tomography for preoperative dental implant measurements	Analysis and processing of images. Actual measurements for the implant planning process.	Exclusive study on the effect of scanning mode on preoperative dental implant measurements.
2015	[18] / Ribolla, EL; Rizzo, P; Gulizzi, V.	On the use of the electromechanical impedance technique for the assessment of dental implant stability: Modeling and experimentation	Modeling	Use of test in bovine bones and finite elements
2015	[19] / Monaco, C; Evangelisti, E; Scotti, R; Mignani, G; Zucchelli, G;	A fully digital approach to replicate peri-implant soft tissue contours and emergence profile in the esthetic zone	Implant simulation, fixation system, drill types	Single implant
2015	[20] / Luangchana, P; Pornprasertsuk-Damrongsri, S; Kiattavorncharoen, S; Jirajariyavej, B;	Accuracy of Linear Measurements Using Cone Beam Computed Tomography and Panoramic Radiography in Dental Implant Treatment Planning	Measurement and planning of the dental implant. Analysis through software	Method for bone measurements.
2015	[21] / Romero, L; Jimenez, M; Espinosa, MD; Dominguez, M.	New Design for Rapid Prototyping of Digital Master Casts for Multiple Dental Implant Restorations	Data processing, multiple dental implants	How to put the dental implant
2016	[22] / Cheng, Y-C; Lin, D-H; Jiang, C-P; Lin, Y-M.	Dental implant customization using numerical optimization design and 3 - dimensional printing fabrication of zirconia ceramic	Numerical modeling of exogenous factors for implant shape include thread pitch, thread depth, maximum implant neck diameter, and body size.	Mechanical properties

In this way, it was possible to identify relevant points for this research, as well as the limitation of each author, identifying research opportunities building the science.

2. Conclusions

This research presented a systematic review focusing on the Support for Decision Making in the Assisted Dental Implant Process.

Through the systematic review of the literature it is possible to identify reference works in the study area and also to verify that the interaction between the medical and engineering areas are fundamental to support the decision of the surgeon and to analyze several characteristics of the surgical process.

With the systematic review, it was possible to find the three primary words, dental implant, human prosthesis design and dental fixation and their respective secondary words, with this after the refinement of the searches in the CAPES portal it was possible to select 17 articles for the systematic review process and to point their contributions and limitations.

As future work, there are some points to be explored as the more detailed review of the articles in order to determine a better method to support decision making, analysis of bibliographic references and to define an algorithm that provides better support to the surgeon in the execution of his work.

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