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New scopes of computational biomechanics in dentistry

Abstract

The application of biomechanics is a few touched issue in the dental community. This is because, is commonly understood that its use refers to the movement of the mandible or the application of forces in orthodontics and implantology. This has caused that, the basic knowledge required in this area and the fundamental concepts, for the research and understanding of the nature of the tissues, have not being very successful. Biomechanics is an area of science that is fundamental in dentistry. It allows the full knowledge of the nature and mechanical properties of dental tissues, the movement of the mandible and the temporomandibular joint and the external agents to which the entire stomatognathic system is subjected. Through it, is possible to have a better understanding of how this system works and in particular the symbiotic relationship that is established between dental tissues. This opens the possibility of having better diagnoses, treatments and find more suitable restoration materials. One of the possible reasons why nowadays is not considered so fundamental, may be due to the fact that it is considered unfeasible to be able to be used, because of the complicated handling for its experimentation. However, the advances in computational resources allowed the development of Computational Biomechanics, which offers the possibility to be used through biomodels of high bio-fidelity (generated by three-dimensional radiological images, which in turn also have their peak, to the advance in computational resources). With this, it is possible to perform biomechanical analysis beyond just movement, also the relationship that exists between dental tissues. This will provide a better understanding of their interaction, which will allow the generation of materials that mimic their synergistic relationship.

Keywords: biomechanics, radiological images, mimic, materials, dental tissues

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Introduction

Computational biomechanics is commonly used for the study of biological systems. It allows simulations that allow to approach reality, in situations that experimentally are complicated or even impossible to be carried out. The mechanical tests carried out by experimental biomechanics do not allow the control of some variables that may occur in living systems or tissues; it is by means of computer simulations that it is possible to control them. It is common to find biomechanical analyses performed with computer simulations, mainly in medical areas such as orthopedics and traumatology.[1] In other areas such as angiology (biomechanical studies of blood circulation in arteries),[2] Rheumatology (biomechanical analysis in the alveolar and pulmonary systems)[3] are of more recent appearance. The benefits and contributions they can offer are wide such as, the generation of new knowledge and the introduction of a new methodology to do research. Nevertheless, there are still areas of medicine in which they would be very useful, but unfortunately, it is not yet a well explored field. One of these branches is dentistry, in which its application is limited. This may be due to the fact that biomechanics in general and particularly computational biomechanics have not been considered as fields of science that are viable to be applied in the study and generation of better materials and treatments, as well as to explain phenomena that occur during the dental treatment and its possible failures.

Methodology

The application of biomechanics in dentistry has been relegated to the mandibular movement, to the movements and forces that are applied in orthodontics and to some orthopaedic devices that are used in dental orthopaedics, Implantology and orthognathic surgery. To a lesser extent, they have been used to analyse dental materials (with the idea that these must be of high hardness) and a much imitated application in the study of the mechanical properties of dental tissues.[4] This is a poor use of biomechanics in dentistry. Although it is very limited to use traditional or experimental biomechanics in this area, computational biomechanics can contribute much more than it seems to be expected. Currently, it is possible to count on tools such as three-dimensional imaging (tomography, magnetic resonance, ultra sound, among others) for the generation of high fidelity biomodels (Figure 1) that allow a better computational biomechanical analysis.[5] However, there is still little that is known about its use.

Figure 1 High bio-fidelity biomodelo of a first molar.

Biomodels with high bio-fidelity of dental organs allows a better analysis of the biomechanics that exist between dental tissues. With this, better restorative materials that imitate the way that these tissues work and are related, can be selected (Figure 2). In addition, it is possible to make analyses that allow determining the reasons why the treatments may fail and what could be done to prevent such a failure (Figure 3). Selecting the type of material that is appropriate for each case should be the basis of Preventive dentistry and dental tissue engineering.

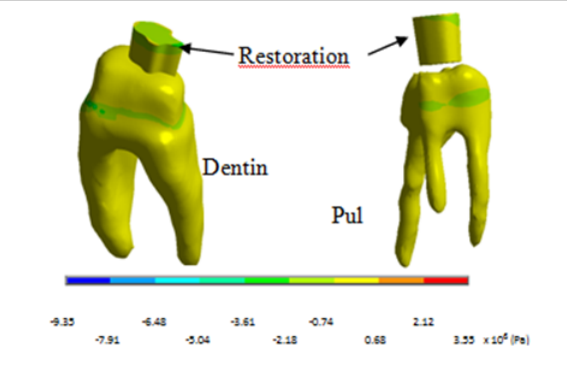

Figure 2 Biomechanical analysis using the Finite Element Method of a dental restoration and the reaction of dental tissues.

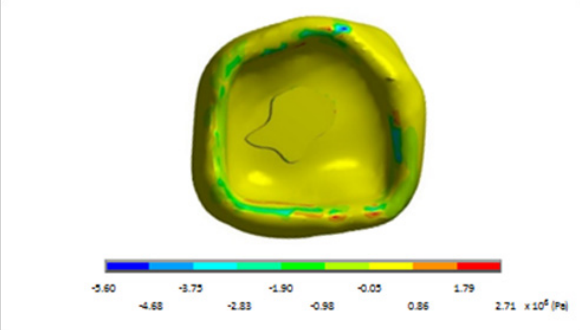

Figure 3 Biomechanical analysis using the finite element method of a dental restoration that suffered misalignment and fracture.

Conclusion

Dentistry must begin to consider biomechanics as a branch of fundamental science, which should be part of it, as it would be the dental anatomy or the physiology of the stomatognathic system. Scientific and technological innovation in the health areas is considerably demanded. The computational biomechanics, offers a response to this demand, at the same time, it contributes to generate new knowledge and considerations to realize quality dentistry.

For this, it is necessary that the dental community have a deep interest in learning what is biomechanics in dentistry and given the task of acquiring the correct concepts, which would allow a better understanding between both areas. Its application in general practice, could allow a better care to patients and ensure a higher success rate of treatments. From the point of view purely of the investigation, it allows to broaden the baggage of knowledge that will take to the dentistry of the future, with intelligent, biocompatible materials that resemble the natural tissues.

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Conflict of interest

Authors declare that there is no conflict of interest.

References

1. Prado AO, Padrón EN, Hidalgo MV, et al. Posibilidad de aplicación de la simulación computacional de tejido óseo en niños con torsión tibial. *Revista Cubana de Ortopedia y Traumatología*. 2017;30(2):193–200.
2. Gharaie SH, Mosadegh B, Morsi Y. *In Vitro* validation of a numerical simulation of leaflet kinematics in a polymeric aortic valve under physiological conditions. *Cardiovascular Eng Technol*. 2018;9(1):1–11.
3. Diciotti S, Nobis A, Ciulli S, et al. Development of digital phantoms based on a finite element model to simulate low-attenuation areas in CT imaging for pulmonary emphysema quantification. *Int J Comput Assist Radiol Surg*. 2017;12(9):1561–1570.
4. Ilie N, Hilton TJ, Heintze SD, et al. Academy of dental materials guidance—resin composites: part I—mechanical properties. *Dental Materials*. 2017;33(8):880–894.
5. Hernández Vázquez RA, Romero Ángeles B, Urriolagoitia Sosa G, et al. Numerical *a*nalysis of *m*asticatory *f*orces on a *l*ower *f*irst *m*olar considering the *c*ontact between *d*ental *t*issues. *Applied Bionics and Biomechanics*. 2018;1:1–15.