Chapter 1
Introduction to Application of Biomedical Engineering in Dentistry

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"Good fences make good neighbors" …"Why do they make good neighbors?"… "Something there is that doesn't love a wall"…."He says again, Good fences make good neighbors" [1].

These are scattered verses from an American poet Robert Frost (1874–1963) in his famous poem *Mending Wall* (published in 1914, North of Boston by David Nutt). In this poem, there is a stone wall between two farms. Farmer 1 asked his neighbor in the spring mending-time to reconstruct the wall. Farmer 2 wondered if he should. The dialogue continued between them with repeating the verse by Farmer 2 "Something there is that doesn't love a wall" followed by the insisting of Farmer 1 relying on the proverb of "Good fences make good neighbors!"

It is interesting that the story still continues between groups of Farmer 1 and Farmer 2 after more than a hundred years. Do we need a wall? "That is the question." We don't know who is right in farms and livestock grazing, but we do know that in today's dentistry. "Something there is that doesn't love a wall" [1].

More broadly, in today's science, technology, and medicine, each field is trying to touch the concept of interdisciplinary. Do we *need* the interdisciplinary approach to succeed? Perhaps not. Do we *need* the interdisciplinary approach to be modern, progressive, and advanced? Definitely yes.

Modern dentistry tries its best to take advantage of linking with other fields, especially biomedical engineering. This book aims to present some of these efforts. Biomedical engineering, itself, is known as an exceedingly multidisciplinary field spanning biology, material science, physics, chemistry, engineering, and medicine. The recent progress in biomedical engineering significantly impacts many relevant areas. Such impacts on dentistry are the focus of this book, in which an interdisciplinary document is presented, that relates biomedical engineering

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and dentistry by introducing the recent technological achievements in engineering with applications in dentistry.

The book will begin by studying the biomaterials in dentistry and materials used intraoperatively during oral and maxillofacial surgery procedures. Next, it will consider the subjects in which biomedical engineers can be influential, such as three-dimensional (3D) imaging, *laser and photobiomodulation,* surface modification of dental implants, and bioreactors. Hard and soft tissue engineering in dentistry will be discussed, and some specific and essential methods such as 3D printing will be elaborated. Presenting particular clinical functions of regenerative dentistry and tissue engineering in the treatment of oral and maxillofacial soft tissues is the subject of a separate chapter. Challenges in the rehabilitation handling of large and localized oral and maxillofacial defects are severe issues in dentistry, which will be considered to understand how bioengineers help with treatment methods in this regard.

Recent advances in nanodentistry will be discussed followed by a chapter on the applications of stem cell-encapsulated hydrogel in dentistry.

Periodontal regeneration is a challenging issue in dentistry and, thus, is going to be considered separately to understand the efforts and achievements of tissue engineers in this matter.

Oral mucosa grafting is a practical approach in engineering and treatment of tissues in ophthalmology, which is the subject of another chapter. Microfluidic approaches became more popular in biomedical engineering during the last decade; hence, one chapter will focus on the advanced topic of microfluidics technologies using oral factors as saliva-based studies. Injectable gels in endodontics is a new theme in dentistry that bioengineering skills can advance its development, specifically by producing clinically safe and effective gels with regeneration and antibacterial properties. Engineered products often need to be tested in vivo before being clinical in dentistry; thus, one chapter is dedicated to reviewing applicable animal models in dental research. The last chapter will cover the progress on the whole tooth bioengineering as a valuable and ultimate goal of many dental researchers.

Reference

1. Frost, R. (1914). *North of Boston*. Henry Holt. New York