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Guest Editorial

Laser holography in dentistry

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A R T I C L E I N F O

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Laser Holography offers a new non-destructive possibility for bridging the void between in vitro and in vivo studies in dentistry and other related fields. It increases the chances of attaining more accurate and more reliable objective diagnosis and treatment therapy. The use of stone and plaster study models has been an old technique and an integral part of any dental practice. Study models also are of great importance for record keeping and are needed for research. Storage of these study models is major issue in relation to space and cost. Various different methods have been used for the three-dimensional (3D) assessment and recording of dental study models. The most notable ones include Holography and Moire Topography. Holography was introduced in 1948. It was the work of Leith & Upatnieks that completely changed the face of holography with the advent of the laser beam or laser topography. Holography then allowed the direct measurement of any 3D displacements seen as accurate as a few micrometres. The major drawback or difficulty with this technique is that there is poor quality of recording of all the details of the study/plaster models, particularly this is seen in the incisor or the anterior region of the study model. One particular advantage of holography is that the recorded films can be stored with the patient's other medical records and this leads to a further step closer towards achieving digital dental study models. However, this cannot truly and totally replace the original plaster models.

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Holography is a new technology which has many applications in dentistry such as study of strain and strain of soldered gold joints, studies of various dental structures, and measurement of elastic deformation of prosthodontic appliances. In Orthodontics, it can be used for the storage of digital dental casts,determination of tooth movement, determination of centre of rotations of teeth, and studies of deformation of jaw bones after orthodontic force application. It can also be used for determination of stress/strain in the periodontal ligament and alveolar bone after orthodontic force application. The evolution and technique of recording holography and holographic interferometry have been described previously in literature.[1]

Holography was introduced by Gabor in 1947 and for this contribution he was awarded the Nobel prize in Physics in 1971. Holography was based on the principal of photography to record the image of an object. Through holography, it became possible to record not only the amplitude, but also the phase of the light wave from an object, giving rise to a three-dimensional lifelike image and was often referred to as 3D photography.[2] Leith and Upatnik applied the laser to holography in 1960.

Holograms of patient dental casts may be useful to solve storage problems by freeing up space used by the plaster models. Study of initial displacement of teeth gives us an insight into the type of tooth movement that will be finally achieved, as well as stress and strain in the periodontal ligament. The stresses produced in the

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periodontal ligament when a force is applied to the tooth has important ramifications and can help in the study of orthodontic tooth movement and periodontal research. The periodontal response to load is divided into three parts of tooth movement: initial strain, lag phase and post lag phase. Initial strain of 0.5 to 1.0 mm occurs in about 1 week because of periodontal ligament displacement, bone bending, intrusion. Initially tooth displacement occurs rapidly within seconds but actual compression requires 1-3 hours.

Tooth displacements have been studied in the past with the following approaches:

1. Analytical models
2. Physical models
3. Direct measurement in vivo

The attempts at creating a mathematical model by analytical approach or photo-elastic techniques have not yielded promising results. Many studies using finite element models (FEM) have been used regularly by assumptions such as:

1. The root anatomy, periodontal ligament and alveolar bone were represented by geometric forms.
2. The physical properties of the supporting structures were assumed to be homogeneous, isotropic and linear whereas the structures of interest are non-homogeneous, anisotropic and nonlinear.

The above shortcomings in the studies on the prediction of tooth movement, under the influence of external forces, can be overcome by the non-invasive techniques of laser holography. Laser holography is a valuable technique that has found numerous applications in dentistry and orthodontics. The technique of holographic interferometry aids in determination of stress and strain and initial displacement of an object. The shortcomings seen in the studies of the prediction of tooth movement can be changed by the non-invasive techniques of laser holography as we can study the real rather structure than analytical models.

Conflicts of Interest

There are no conflicts of interest.

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