New Mandibular Distractor Device

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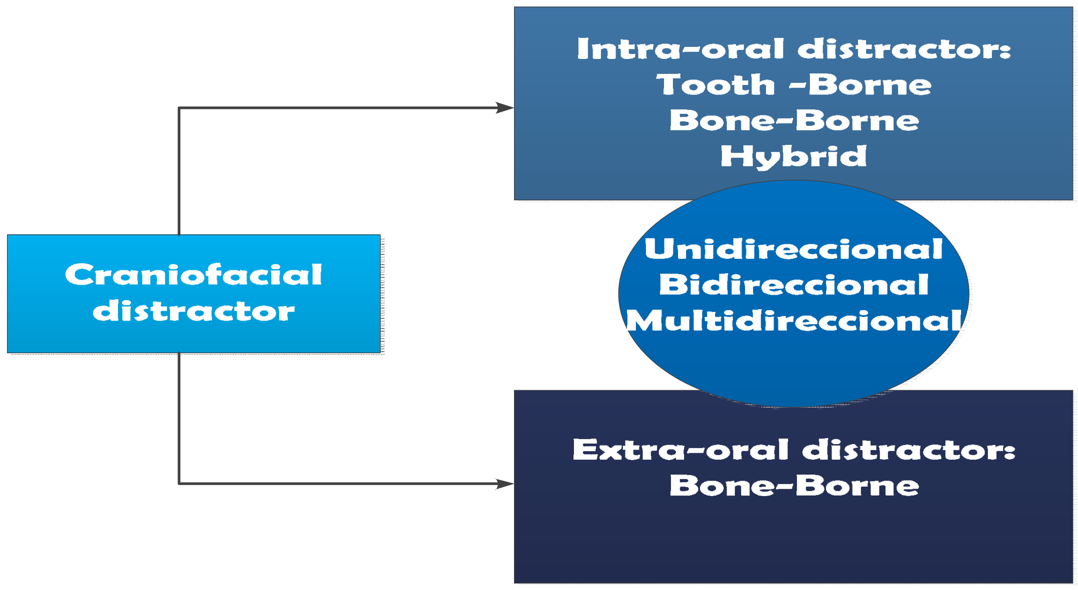
INTRODUCTION

Mandibular defects can range from isolated segmental defects to large extensive areas of bone loss involving the entire jaw. These defects are often congenital, a result of trauma, infection, or resection of benign and malignant tumors. Distraction osteogenesis is a medical procedure that has proved to be a reliable method for reconstructing missing segments of bone.

Distraction osteogenesis is the technique of gradual bone lengthening that allows the body's natural healing mechanisms to generate new bone for augmenting or lengthening bone. The regeneration of new bone between the two surfaces is achieved by using a mechanical device called a distractor. The distractor is rigidly fixed to the bone segments and has the ability to keep the segments in the desired plane of distraction and separate them at a controlled rate. Originally used for lengthening long bones, this process has gradually been adapted to the maxillofacial region.

STATE OF THE ART

Mandibular distraction devices currently available are anchored directly in the bone with small screws either for the extra-oral or intra-oral applications. These devices require manual activation, which is contrary to the ideal of distraction where a continuous and progressive separation of the bone ends is desirable. This issue is partly solved by automatic distractors presented in some recent publications [1]. Nevertheless, there are still three essential aspects to be settled, namely: size of the device, anchoring and controlling the direction of the distraction.



OBJECTIVES

Research into an apparatus and method for the distraction and supporting of tissues that requires two degrees of freedom and that operates in a programmable and autonomous fashion. The programmable and autonomous distractor comprises the anchoring rods and the body of distraction, which includes the external structure, the electric motors, the control unit that allows progressive and automatic distraction, the communication unit that allows customisable programming of the device and the power supply required for the operation. The distractor may be implantable and, in the case of the mandible, is applied intra-orally, and its anchoring is done directly on the teeth, preferably between the first molar and the first premolar.

Figure 1 – Extra-oral mandibular distractor in a child with severe hypoplasia [2].

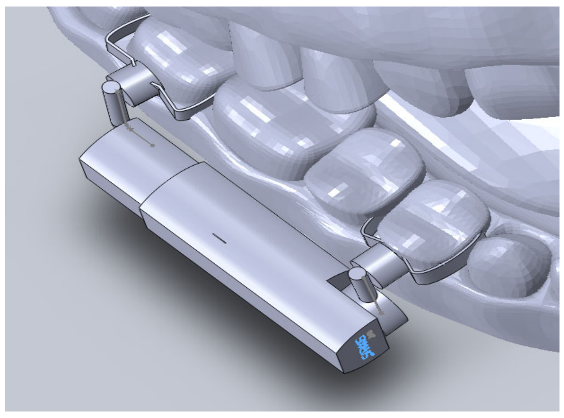


Figure 2 – Prototype of a mandibular distractor.

Figure 3 – 3D modeling of a real human Mandible .

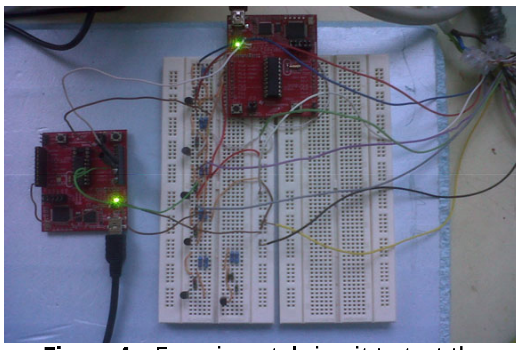
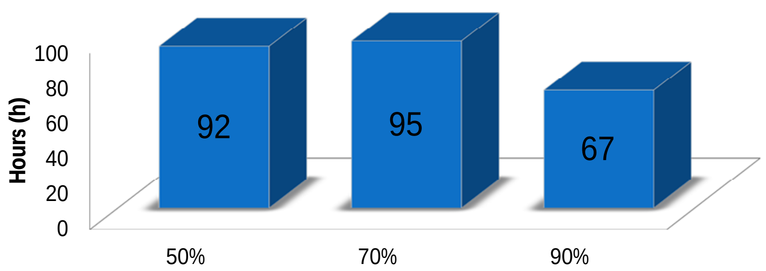


Figure 4 – Experimental circuit to test the Zinc-Air batteries.



Graphic 1 – Duration time of Zinc-Air batteries in different relativity humidity levels.

DEVELOPED WORK

- ✓ Protection of the invention by submitting a patent (20121000038753)
- ✓ 3D-modelling of a real human mandible based on tomographic computer scan, using ABS plastic as the material. The 3D mandible allowed us to acquire better dimensional knowledge of the space available to design the distractor.
- ✓ Zinc-Air batteries were chosen has a possible solution for powering the device. They have one of the highest charge densities available on the market. Experimental tests were made to evaluate the endurance of the batteries in an intra-oral environment. The intra-oral environment is characterised by high humidity levels and temperatures around 37ºC. The tests already made have shown that the batteries could endure such conditions, but there were some differences in the life-time of the batteries.

FUTURE

- Evaluate the performance of Zinc-Air batteries when in contact with saliva. In order to protect the batteries, a porous membrane of Teflon will be used.
- Build the first prototype of the mandibular distractor (Figure 2).
- Design and assemble all the electronics involved in the device.
- Experimental tests of the force applied by the distractor.

References:

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