In vitro flexural strength evaluation of a mini-implant prototype designed for Herbst appliance anchorage

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Abstract

Aim: The purpose of this study was to evaluate the limit of flexural strength of a mini-implant prototype designed for Herbst appliance anchorage. **Methods:** After sample size calculation, four specimens with the new mini-implant were submitted to a single cantilever flexure test using a universal testing machine. The limit of flexural force strength was calculated. **Results:** The mini-implant prototype showed a limit of flexural force of 98.2 kgf, which was the lowest value found. **Conclusion:** The mini-implant prototype designed for Herbst appliance anchorage can withstand higher strength than the maximum human bite reported in the literature.

Keywords: Orthodontic appliances. Orthodontics. Herbst appliance. Mini-implant.

Editor's summary

The Herbst appliance is a treatment possibility for Class II malocclusion in growing patients. By protruding the mandible, the Herbst appliance aims to stimulate mandibular growth, resulting in improvement in its effective length. However, the major changes caused by the Herbst appliance are dentoalveolar, where the appliance is anchored. Due to the development of skeletal anchorage mechanisms, a question arises: How would be the effects of the Herbst appliance using skeletal anchorage? Before evaluating if the appliance's orthopedic effects would be optimized changing the kind of anchorage, it is necessary to evaluate if the mini-implants are able to withstand the muscle strength that opposes to the mandibular advancement. The purpose of this study was to evaluate, in vitro, the limit of flexural strength of a mini-implant prototype especially designed for Herbst appliance anchorage.

Four specimens were used in this experiment. Each one had three parts: the mini-implant prototype; a metal support block, which acted as the support for the flexure force; and a straight telescopic tube (Dentaurum) of the Herbst appliance

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FIGURE 1 - Mini-implant prototype with screw, in lateral view.

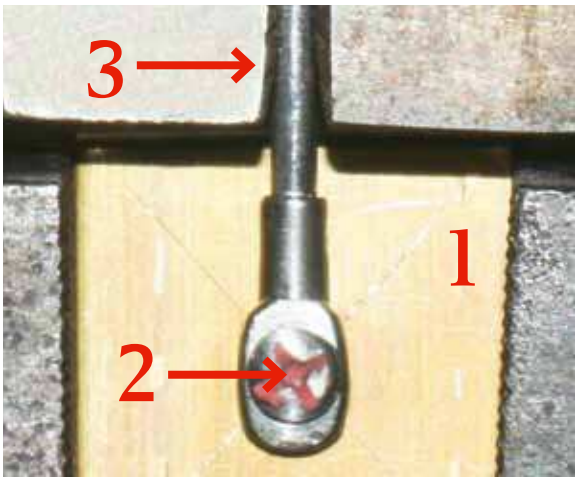

FIGURE 2 - Specimen used in test (1) metal block, (2) mini-implant prototype inserted in the metal block with the screw attached to the telescopic tube, (3) telescopic tube of Herbst appliance.

(Figs 1 and 2). A single cantilever flexure test was performed in which the point of force application occurs with a distance of the specimen base generating a momentum. Flexural traction was applied at 0.5 mm per minute until the maximum strength was reached. The values were recorded, and a graph of strength x dislocation was constructed, using a specific program of the testing equipment.

After the maximum resistance flexural essays performed on the specimens, a mean of 98.9 Kgf, with a standard deviation of 0.6, and a maximum and minimum value of 98.2 and 99.0 Kgf, respectively, were found. The mini-implant prototype, alone, could resist the flexural forces transferred by the Herbst appliance originated by human bite strength (75.6 Kgf).

However, speculations on the major risk of mini-implant failure used as Herbst appliance anchorage are related to bone x mini-implant interface. Therefore, other in vitro tests should be performed to evaluate the resistance of the mini-implant prototype when it is inserted in bone before clinical experiments in humans can be performed.

Questions to the authors

1) After the verification that the developed mini-implant can withstand Herbst appliance anchorage, what would be the next step?

To prove that the mini-implants could be used as Herbst appliance anchorage, a clinical study should be done in humans. However, other studies are still necessary, like a study in animals using mini-implants for Herbst appliance anchorage, which will be our next study.

2) What are the clinical perspectives for Herbst appliance with mini-implant anchorage?

We have not sufficient information to answer this question based on scientific evidences. However, if this anchorage system becomes possible, we could imagine a mandibular advancement without the undesirable effects produced, especially, in the lower incisors.

3) What inspired you to search for this innovation for the Herbst appliance?

The possibility of using an orthopedic appliance without dental anchorage, expressing all the potential of skeletal stimulation and possibly avoid the undesirable effects on teeth.

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