SDM
College of Dental Sciences & Hospital
Dhavalnagar, Sattur, Dharwad - 580009, Karnataka, INDIA
Recognised by Dental Council of India, New Delhi

SHRI
DHARMASTHALA
MANJUNATHESHWARA
UNIVERSITY

SHRI DHARMASTHALA MANJUNATHESHWARA UNIVERSITY, DHARWAD, KARNATAKA

Effect of different storage temperature and prolonged use on mechanical properties of NiTi, Cu-NiTi, β -titanium and SS orthodontic arch wires: An in vitro study

DR. JAIVRAT GUPTA

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Under the guidance of

DR. AMEET V. REVANKAR

ADDITIONAL PROFESSOR

DEPARTMENT OF ORTHODONTICS AND DENTOFACIAL ORTHOPEDICS
S.D.M COLLEGE OF DENTAL SCIENCES AND HOSPITAL, SATTUR, DHARWAD.

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ABSTRACT

BACKGROUND

Most commonly used Orthodontic wires in day-to-day practice are Stainless steel (SS), Nickel titanium (Niti), Copper Nickel titanium (Cu-Niti) and Beta titanium (β-titanium). Since Niti and Cu-Niti are temperature sensitive wires also due to their mechanical properties there could be a probability that the properties of these wires are affected by the temperature in which they are stored. Since the orthodontic treatment duration is months to years there are multiple instances where-in the same wire has to be engaged for a long duration in the patients mouth and this could also change the properties of wires.

OBJECTIVES

The objective of this study is to evaluate whether storage temperature or prolonged use has any effect on the mechanical properties of SS, Niti, Cu-Niti and β-titanium.

MATERIALS AND METHODS

The study was divided into 2 parts, the first parts was to evaluate the effect of storage temperature, 36 unused wires were collected for all four groups - SS, Niti, Cu-Niti and β-titanium and were subdivided into 3 subgroups of storage temperatures 16°C, 37°C and 45°C. All subgroup had 12 wires from each group. The wires were stored at the fixed temperature for 24 hours before the three-point bend test was performed on an Universal Instron testing machine (UiTM) to check for the load/displacement values. The second parts was to evaluate the effect of prolonged use, the study groups were- SS, Niti, Cu-Niti and β-titanium and were subdivided into 3 subgroups of prolonged use for 6 weeks, 8 weeks and 12 weeks. Twelve wires from each group were retrieved after 6 weeks, 8weeks and 12 weeks. These wires were cleaned with 70% isopropyl alcohol and a three point bending test was performed to evaluate the load/displacement values.

RESULTS

It was observed that storage temperature had no effect on the load deflection values of SS and β-titanium whereas Niti and Cu-Niti had a significant difference in the load deflection values. After prolonged use SS and Cu-Niti had no changes in the load deflection values whereas Niti and β-titanium showed significant changes in their load deflection values.

CONCLUSION

It is essential to monitor the storage temperature of Niti as well as Cu-Niti as it can affect the mechanical properties. The prolonged use of Niti and β-titanium for until 12 weeks should be avoided as it may change their mechanical properties.

KEYWORDS

Stainless steel, Nickel titanium, Copper Nickel titanium, Beta titanium, storage temperature, prolonged use, three point bend test, orthodontic wires, load/deflection value