Short Communication

Comparison of the Retentive Characteristics of Cobalt-Chromium and Commercially Pure Titanium Clasps Using a Novel Method

Edward T. P. Tse, BDS, MDS[a]/Leo Y. Y. Cheng, MPhil[b]/Henry W. K. Luk, PhD[c]/
Frederick C. S. Chu, BDS, MSc, PhD[d]/John Chai, BDS, MS, MJ, DLaw[e]/Tak W. Chow, BDS, MSc, PhD[d]

This study aimed to compare the retentive forces of cast cobalt-chromium (Co-Cr) and commercially pure titanium (cpTi) clasps. A clasp assembly comprising a pair of symmetrical clasps was made to fit the opposite halves of a hardened stainless-steel sphere. This twin clasp was designed to counterbalance the tipping forces when the clasp assembly was drawn from the sphere. A total of 120 clasp assemblies were fabricated in cast Co-Cr and cpTi and placed at undercut depths of 0.25 mm, 0.50 mm, and 0.75 mm (n = 20 for each). For Co-Cr clasps, the retentive forces at these undercuts depths were 2.34 ± 0.23 N, 4.65 ± 0.35 N, and 7.56 ± 0.50 N, respectively. The corresponding retentive forces for cpTi clasps were 1.24 ± 0.13 N, 2.34 ± 0.23 N, and 3.70 ± 0.27 N. The retentive force of cpTi clasps was approximately half that of Co-Cr clasps for the same undercut depth. *Int J Prosthodont 2006;19:371–372.*

Although cobalt-chromium alloy has many favorable mechanical properties for the construction of a removable partial denture framework, it is far less ideal as a clasp material. Titanium is a possible alternative, but the retentive force of titanium clasps has been investigated by only a few studies using simulated abutment teeth.[1–4] The purpose of this study was to compare the retentive forces of cobalt-chromium (Co-Cr) and commercially pure titanium (cpTi) clasps using a novel method of a double-clasp assembly.

Materials and Methods

A total of 120 clasp assemblies were fabricated in cast Co-Cr (Economy Ingot Alloy, Nobilium) and cpTi (Pure titan A Class 2, J. Morita) placed at undercut depths of 0.25 mm, 0.50 mm, and 0.75 mm (n = 20 for each). The clasp assembly consisted of a symmetric pair of clasps that were 13 mm in length and made to passively contact the opposite halves of a hardened stainless-steel sphere of 18.5 mm in diameter (Fig 1). Approximately one quarter of the length of each clasp engaged the sphere below its survey line. All castings were inspected under 2.5× magnification and radiographed to exclude those with defects or porosities. Approximately 2% of the Co-Cr castings and 20% of the cpTi castings were rejected. The sphere was connected rigidly to a brass rod, which was aligned and mounted on the crosshead of a tensile-load testing machine (Model 1185, Instron). The castings were connected to the load cell by a metal chain that allowed the test assembly to rotate freely and free from twists. The crosshead speed was set at 10 mm/min. Each clasp assembly was drawn away from the sphere 5 times. The retentive force of a single clasp was calculated as half of the vertically directed force (N) required to draw the clasp assembly away from the sphere.

Results

For Co-Cr clasps, the mean (± SD) retentive forces at 0.25-mm, 0.50-mm, and 0.75-mm undercuts were 2.34 ± 0.23 N, 4.65 ± 0.35 N, and 7.56 ± 0.50 N, respectively. The corresponding retentive forces for cpTi clasps were 1.24 ± 0.13 N, 2.34 ± 0.23 N, and 3.70 ± 0.27 N,

[a]Former Postgraduate Student in Prosthodontics, Faculty of Dentistry, University of Hong Kong, Hong Kong, China.
[b]Honorary Research Associate, Faculty of Dentistry, University of Hong Kong, Hong Kong, China.
[c]Tutor in Dental Technology, Faculty of Dentistry, University of Hong Kong, Hong Kong, China.
[d]Associate Professor, Faculty of Dentistry, University of Hong Kong, Hong Kong, China.
[e]Professor Emeritus, Northwestern University, Evanston, Illinois.

Correspondence to: Dr Frederick C. S. Chu, Reception and Primary Care Clinic, Prince Philip Dental Hospital, 34 Hospital Road, Hong Kong, China. Fax: +852 25470164. E-mail: cschu@hkucc.hku.hk

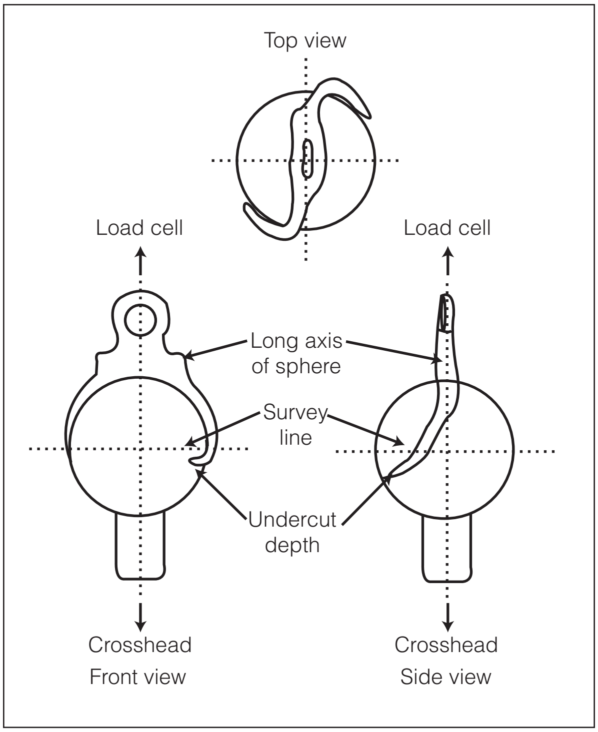
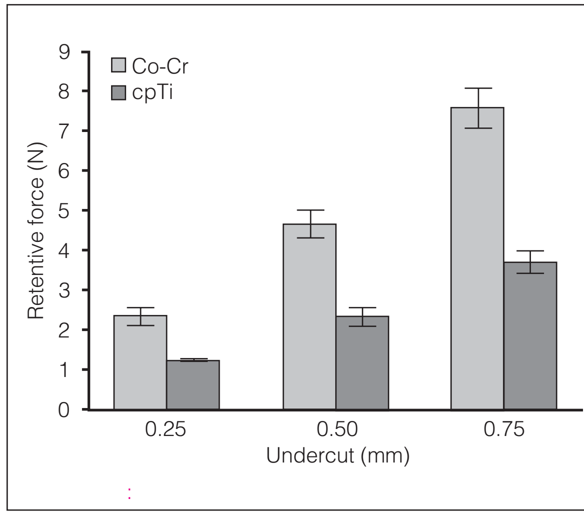


Fig 1 *(left)* Design of the clasp assembly.

Fig 2 *(below)* Mean retentive force (± SD) of clasps cast in cobalt-chromium (Co-Cr) and commercially pure titanium (cpTi).



respectively. Two-way analysis of variance (ANOVA) revealed a statistically significant difference in the retentive forces between Co-Cr and cpTi clasps, and between the different undercuts ($P < .05$) (Fig 2). One-way ANOVA and Newman-Keuls multiple comparison tests showed that the retentive forces of the clasps made of the 2 materials and at different undercuts were significantly different ($P < .05$), with the exception of Co-Cr at 0.25 mm and cpTi at 0.5 mm ($P > .05$). The retentive forces of the clasps were linearly proportional to the undercut depths ($R^2 = 0.97$ for Co-Cr; $R^2 = 0.95$ for cpTi). For cpTi clasps, the retentive forces increased by approximately 1.23 N for every 0.25-mm increase in undercut.

Discussion

The intended use of the twin clasp design was to counterbalance the tipping force when the clasp assembly was drawn from the sphere. The chain allowed for self-centering and alignment of the test assembly. Reciprocal arms, rests, and guide planes were omitted from this setup to minimize the effect of frictional force from these components. The retentive force of the cpTi clasp was approximately half that of the Co-Cr clasp. This can be explained by the modulus of elasticity of cpTi (116 GPa), which is approximately half that of Co-Cr (206 GPa). Given the advantage of superior flexibility, cpTi clasps can engage greater undercuts and can be placed more gingivally for improved esthetics. However, a limitation of cpTi clasps is that if there is a lack of undercut, retention will be compromised. Furthermore, the higher rate of casting porosity of cpTi in comparison with that of Co-Cr may affect whether cpTi is the material of choice.

Conclusion

The retentive force of cpTi clasps was approximately half that of Co-Cr clasps for the same undercut depth.

References

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