

# Clasp Fatigue Study Review

## Deformation and retentive force following *in vitro* cyclic fatigue of cobalt-chrome and aryl ketone polymer (AKP) clasps<sup>1</sup>

**AUTHORS:** Marie A, Keeling A, Hyde TP, Nattress BR, Pavitt S, Murphy RJ, Shary TJ, Dillon S, Osnes, Wood DJ.

**JOURNAL:** Dental Materials 35 (6) e113-e121 [2019]

### INTRODUCTION

Removable partial dentures (RPDs) are widely used to replace missing teeth. Cobalt chrome (CoCr) is perceived as the most popular material for RPD construction, but the material has limitations when used for clasps, including work hardening, distortion, and eventual fracture of clasp arms when stressed beyond their elastic limit.<sup>2-7</sup> High performance polymers, such as aryl ketone polymer (AKP), have the potential to engage and disengage undercuts without being stressed beyond their limit.

### PURPOSE OF THE STUDY

Compare the retentive force of individual clasps made from CoCr or an AKP material (Ultaire® AKP) following prolonged fatigue testing along ideal and non-ideal paths of removal and assess 3D deformation of the active and passive clasp tips.

### STUDY DESIGN

CoCr and AKP clasps were manufactured in their standard, respective processes, digitally scanned prior to testing, then cycled 15,000 times over an e.max analogue crown in artificial saliva. Retentive load was measured *in situ*, as a function of cycles. Clasps were rescanned to assess deformation and along with their antagonists subjected to SEM to assess localised wear.

### RESULTS

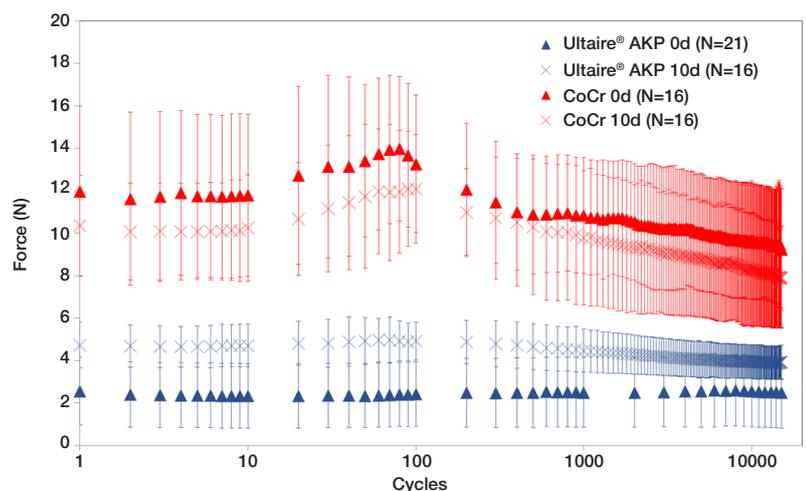
- Ultaire® AKP clasps showed significantly less permanent deformation and a more consistent retentive force than CoCr clasps.
- Ultaire® AKP demonstrated less clasp-to-clasp variability.

### CONCLUSION

**Ultaire® AKP clasps maintain shape with less distortion than metal.**

Unlike CoCr, the Ultaire® AKP clasps did not work harden, nor did they have as large a reduction in retentive force and accompanying permanent deformation. The retentive force for the Ultaire® AKP clasps was consistent over 15,000 cycles of fatigue-mimicking, prolonged clinical use. The AKP material was more robust, showing minimal deformation even in non-ideal paths of removal, as many patients would routinely use.

**Clasp Retention Force Over 15,000\* Insertion/Removal Cycles**



\*15,000 cycles is roughly equivalent to five years, assuming eight insertion/removal acts each day.

**Distortion Results of Pre- and Post-Cycled Scans**

	Ultaire® AKP		CoCr	
	0°	10°	0°	10°
<b>Active Clasp Insertion Path</b>	0°	10°	0°	10°
<b>Mean Distortion (mm)</b>	0.030 ± 0.024	0.019 ± 0.016	0.105 ± 0.095	0.319 ± 0.195

## REFERENCES

1. Marie A, Keeling A, Hyde T, et al. Deformation and retentive force following *in vitro* cyclic fatigue of cobalt-chrome and aryl ketone polymer (AKP) clasps. *Dent Mater*. 2019. <https://doi.org/10.1016/j.dental.2019.02.028>.
2. Ketenes HM, Mulder J, Käyser AF, et al. Fit of direct retainers in removable partial dentures after 8 years of use. *J Oral Rehabil*. 1997;24(Feb (2)):138–42.
3. Ghani F, Mahood M. A laboratory examination of the behavior of cast cobalt-chromium clasps. *J Oral Rehabil*. 1990;17:229–37.
4. Behr M, Zeman F, Passauer T, Koller M, et al. Clinical performance of cast clasp-retained removable partial dentures: a retrospective study. *Int J Prosthodont*. 2012;25(March–April (2)):138–44.
5. Hofmann E, Behr M, Handel G. Frequency and costs of technical failures of clasp- and double crown-retained removable partial dentures. *Clin Oral Investig*. 2002;6:104–8.
6. Vallittu PK, Kokkonen M. Deflection fatigue of cobalt-chromium, titanium, and gold alloy cast denture clasp. *J Prosthet Dent*. 1995;74:412–9.
7. Grundström L, Nilner K, Palmqvist S. An 8-year follow-up of removable partial denture treatment performed by the public dental health service in a Swedish county. *Swed DentJ*. 2001;25(2):75–9.

