# A 5-Year Retrospective Study of Cobalt-Chromium–Based Single Crowns Inserted in a Private Practice

Anders Örtorp, DDS, PhD[a]/Aron Ascher[b]/Per Svanborg, CDT[c]

The aim of this retrospective study was to evaluate the clinical performance of cobalt-chromium (Co-Cr) single crowns. Ninety restorations were placed in 55 patients, and follow-up examinations were performed annually for 5 years. Six patients (8 crowns) were regarded as dropouts. During the follow-up period, 15 (17%) crowns/abutment teeth experienced some type of complication; 8 (9%) of these were regarded as failures. The cumulative survival rate was estimated at 90.3% over 5 years, though only 3 (3%) crowns had complications that could be related to the crown material. The results suggest that Co-Cr single crowns are a promising alternative to other alloys used in fixed prosthodontics. *Int J Prosthodont 2012;25:480–483.*

The use of cobalt-chromium (Co-Cr) in metal-ceramic constructions has increased in recent years, largely because of its low costs and favorable material properties compared with noble metal alloys. However, the clinical data available for cast Co-Cr crowns are limited. This investigation aimed to evaluate the 5-year clinical performance of Co-Cr–based metal-ceramic single crowns.

[a]*Associate Professor, Department of Prosthetic Dentistry/Dental Materials Science, Institute of Odontology, The Sahlgrenska Academy, University of Gothenburg, Göteborg, Sweden.*
[b]*Research Fellow, Department of Prosthetic Dentistry/Dental Materials Science, Institute of Odontology, The Sahlgrenska Academy, University of Gothenburg, Göteborg, Sweden.*
[c]*Assistant Professor, Department of Prosthetic Dentistry/Dental Materials Science, Institute of Odontology, The Sahlgrenska Academy, University of Gothenburg, Göteborg, Sweden.*

***Correspondence to:*** *Dr Anders Örtorp, Department of Prosthetic Dentistry/Dental Materials Science, Institute of Odontology, Box 450, SE-405 30 Gothenburg, Sweden. Fax: +46 31 786 3193. Email: anders.ortorp@odontologi.gu.se*

## Materials and Methods

Ninety restorations were placed in 55 patients (35 men and 20 women) with a mean age of 60.1 years (range: 37 to 83 years) between May 2000 and October 2005 in a private practice in Sweden (Table 1). Two dentists who were highly experienced in prosthodontics treated the patients. All patients had teeth or fixed prostheses in the opposing arch except for 1 patient (2 crowns) who had a removable partial denture at the time of crown cementation. The reasons/diagnoses for crown therapy included: old/defective or lost fillings (n = 32), tooth/filling fracture (n = 26), reconstruction/loss of old crown (n = 20), caries (n = 8), and correction of the occlusion (n = 4). Sixty-one abutment teeth were treated endodontically, and 38 were restored with posts at the time of crown cementation (Table 2). Twenty-nine of these posts were produced clinically (23 screw posts, 6 Composiposts, Unident) and 9 were custom-made cast posts.

The teeth were prepared with a deep chamfer and standardized as much as possible. A hydrocolloid (Image, DUX Dental) and alginate (BluePrint, Dentsply) material were used for the impressions in a prefabricated tray (COE metal impression tray, GC). All crowns were manufactured by the same dental

**Table 1** Distribution of Co-Cr Crowns by Region

| Region | Maxilla | Mandible | Total |
|---|---|---|---|
| Incisor | 1 | 4 | 5 |
| Canine | 0 | 1 | 1 |
| Premolar | 8 | 14 | 22 |
| Molar | 23 | 39 | 62 |
| Total | 32 | 58 | 90 |

**Table 2** Distribution of Co-Cr Crowns by Pretreatment Dental Status of the Abutment Tooth

| Region | Vital | Endodontically treated | Post and core |
|---|---|---|---|
| Incisor | 5 | 0 | 0 |
| Canine | 0 | 1 | 1 |
| Premolar | 5 | 17 | 14 |
| Molar | 19 | 43 | 23 |
| Total | 29 | 61 | 38 |

**Table 3** Reasons for Losses to Follow-up Over 5 Years

| | Moved/new dentist | Deceased/illness | Noncompliant | Total |
|---|---|---|---|---|
| No. of patients (%) | 1 (2) | 3 (5) | 2 (4) | 6 (11) |

laboratory (Arvidssons Laboratory, Alingsås, Sweden) and standardized as much as possible. The crowns were fabricated using the lost wax technique, and the constructions were invested in a graphite-free phosphate-bonded investment (GC Fujivest Super, GC). The casts were created in an induction casting machine (Neutrodyn Easyti, Manfredi) using a Co-Cr alloy (61% Co, 26% Cr, 6% Mo, 5% W, 1% Si, 0.5% Fe, 0.5% Ce, ≤ 0.02% C; Wirobond C, BEGO). Feldspathic porcelain (Noritake Ex3, Noritake Dental Supply or Duceram Plus, Degudent) was fused to the metal. The majority of crowns were veneered using Noritake Ex3. The veneering thickness layer was between 1.0 and 2.0 mm. All crowns were covered with porcelain occlusally. The crowns were cemented using either zinc phosphate cement (n = 79; Harvard cement, Harvard Dental) or composite resin (n = 11; RelyX Unicem, 3M ESPE). A maximum of four crowns were placed in any given patient.

The following data were collected from the patients' records prior to crown cementation: sex, age at crown delivery, reason for crown therapy, tooth position, endodontic treatment, post material, number of crowns cemented, type of cement, and occluding teeth in the opposing arch. The dentist who performed the crown therapy also conducted clinical follow-up examinations once a year for 5 years. Patients were asked to contact the clinic if they experienced any problems with their crowns or abutment teeth. The examinations consisted of a complete dental and oral hygiene assessment, including examination of radiographs and crown stability and a full cariologic and periodontal evaluation. From September 2010 to June 2011, the authors registered the records of all patients that had received Co-Cr crowns.

## Results

During the 5-year observation period, 6 patients (8 crowns) were recorded as dropouts (Table 3), and a further 8 crowns (8 patients) were registered as failures. Thus, 41 patients (74 crowns) were tracked throughout the follow-up period. In total, 15 (17%) crowns/abutment teeth experienced some type of complication (Table 4), of which 8 (9%) were failed crowns (eg, fracture of the abutment tooth or loss of the post and core or crown). In these failed cases, 4 abutment teeth were extracted (4%) because of root fractures. All 4 extracted teeth had undergone root canal treatment, and 2 had posts and cores. Further, 3 (3%) abutment teeth lost their post-and-core crowns. Two of these patients were treated with new

**Table 4** Complications Related to the 90 Cemented Co-Cr Crowns Over 5 Years of Follow-up

| | Anterior | Posterior | Endodontically treated | Vital | Total |
|---|---|---|---|---|---|
| Veneer fracture (chipping) | 0 | 1 | 1 | 0 | 1 |
| Caries | 0 | 1 | 0 | 1 | 1 |
| Loss of retention (crown) | 0 | 2 | 1 | 1 | 2 |
| Loss of retention (post and core) | 0 | 3* | 3 | 0 | 3 |
| Endodontic problem | 0 | 4 | 2 | 2 | 4 |
| Extraction (root fracture) | 0 | 4 | 4 | 0 | 4 |
| Total | 0 | 15 | 11 | 4 | 15 |

*Two screw posts and one cast post.

**Table 5** Life Table Analysis of Co-Cr Crowns

| Period (y) | Examined crowns | Lost to follow-up | Surviving* | Failed† | CSvR (%) | CScR (%) |
|---|---|---|---|---|---|---|
| Crown cementation | 90 | 0 | 0 | 0 | 100.0 | 100.0 |
| 1 | 87 | 1 | 2 | 2 | 97.7 | 95.3 |
| 2 | 84 | 1 | 1 | 2 | 95.3 | 91.7 |
| 3 | 79 | 4 | 1 | 1 | 94.1 | 89.3 |
| 4 | 75 | 2 | 2 | 2 | 91.6 | 84.0 |
| 5 | 74 | 0 | 1 | 1 | 90.3 | 81.5 |
| Total | 74 | 8 | 7 | 8 | 90.3 | 81.5 |

CSvR = cumulative survival rate; CScR = cumulative success rate.
*A crown was considered as surviving if it did not succeed because of minor complications such as caries, treatable endodontic issues, or minor veneer fractures.
†A crown was considered as failed if it was remade because of a loose crown, loose post and core, or if the abutment tooth was extracted.

restorations, and 1 patient did not show up for retreatment. In addition, 1 (1%) crown initially cemented with zinc phosphate cement lost retention and was replaced with a new crown.

In patients who had complications but whose crowns were judged as surviving, three (3%) teeth needed endodontic treatment, and a root resection was performed on one of them. One (1%) root on a mandibular first molar was fractured, but the patient declined treatment. Caries was treated in one (1%) tooth. One (1%) crown initially cemented with zinc phosphate cement lost retention and was recemented. No metal fracture occurred in the follow-up period, although there was one (1%) minor cohesive fracture that could be polished. No effects on the surrounding gingival tissues were reported, and no patients had esthetic complaints such as gingival discoloration. Complications were not seen at a specific time but were evenly distributed over the 5-year follow-up period. After 5 years, the cumulative survival rate was 90.3%, and the cumulative success rate was 81.5% (Table 5). A crown was considered a success when no complications of the crown or abutment tooth occurred.

## Discussion

In a review[1] on complications in fixed prosthodontics, the 5-year survival rate of metal-ceramic crowns was 95.6% (confidence interval [CI]: 92.4% to 97.5%). Another study[2] reported a 5-year survival rate of 76%. In this study, the cumulative survival rate was 90.3%. However, the large numbers of teeth with post-and-core restorations (42%) must be considered since abutment teeth treated with post-and-core crowns are linked to certain complications,[3] while root fillings are associated with reduced survival times for crowns.[2]

The most common complications in this study were root fractures (4%) and loss of posts and cores (3%). These complications probably have causes other than the Co-Cr material since the preparation and cementation techniques are the same as those for other metal-ceramic restorations. Complications likely to be related to the crown material, such as veneer fracture or loosened crowns, had a complication rate of 3%. In a systematic review,[4] the incidence of veneer fractures alone was 3% (CI: 2.7% to 6%), and the reported retention losses were 2% (CI: 1% to 23%) over

a mean period of 6 years. During the follow-up period, no biologic complications related to the crown material were reported.

One limitation of this study is the absence of a control group. Nevertheless, Co-Cr was the only material used at the clinic in question at the time of the study. Therefore, the results were compared with similar studies.[1–5]

While this study used a relatively small number of patients, to the authors' knowledge, no other studies on cast Co-Cr crowns have been published. Patient loss was considered minor (11%) with respect to the 5-year observation period. Crowns were fabricated at one laboratory, and the study was based at one private practice. This practice-based study has the advantage of being set in a general dental setting. This provided a patient cohort that happened to be at the clinic at the time, and while variations in tooth condition prior to crown therapy may have a diluting effect on the outcome, it suggests that it is representative of a typical patient cohort at a private practice in a major Swedish city.

Co-Cr shows promise, as demonstrated by the cast Co-Cr crowns analyzed and a recent report on laser-sintered Co-Cr crowns.[5] Indeed, Co-Cr use is likely to rise as different digital processing techniques such as milling or laser technology[5] become increasingly available for fabricating crowns.

## Conclusions

This 5-year study suggests that Co-Cr is a promising alternative to other alloys used in prosthodontics. However, more studies are needed to further evaluate the long-term success of both single crowns and fixed dental prostheses made with this material.

## Acknowledgments

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*Literature Abstract*

**How much do resin-based dental materials release? A meta-analytical approach**

The aim of this meta-analysis was to review the release of compounds by resin-based dental materials in the oral environment. Review papers (n = 22) that met the inclusion criteria were included in this analysis. Seven hundred sixteen separate data and 25 eluates were gathered in a three-dimensional customized database to perform standardized calculations. A meta-analysis approach was used to calculate the weighted geometric mean concentration of the eluate from each study. HEMA (123.59886 μmol/mm$^3$) was released the most among all monomers, followed by TEGDMA (2.51396 μmol/mm$^3$), UDMA (0.96373 μmol/mm$^3$), and bis-GMA (0.00143 μmol/mm$^3$). Although the amount of additives in resin-based materials is low, a similar or greater concentration than the monomer was released into the oral environment. The release results calculated were later used to estimate the possible release of eluates with reference to restoration size. Guidelines for standardization were suggested based on the results of the meta-analysis. The authors emphasized that the data from this meta-analysis be treated with caution due to interheterogeneity of the study protocol. Further research is required to identify the long-term release of components from resin materials.

**Van Landuyt KL, Nawrot T, Geebelen B, et al.** *Dent Mater* 2011;27:723–747. **References:** 138. **Reprints:** Dr K.L. Van Landuyt, Leuven BIOMAT Research Cluster, Department of Conservative Dentistry, School of Dentistry, Oral Pathology and Maxillo-Facial Surgery, Catholic University of Leuven, Kapucijnenvoer 7, B-3000 Leuven, Belgium. Fax: +3216332752—*H.D. Khoo, Singapore*