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(CASE REPORT)

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# The use of ribbon sprue in the fabrication of a nickel-chromium coping: A laboratory case report

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## Abstract

This study aimed to evaluate the casting quality of nickel-chromium copings fabricated using ribbon sprue designs. Ribbon sprues were fabricated from heat-resistant materials and attached to wax patterns. A centrifugal casting technique was employed to deliver molten metal into the mold. After casting, the copings were assessed from mesial-distal, buccal-lingual, and occlusal-cervical views. Parameters examined included marginal fit, surface porosity, shrinkage, and the presence of fractures. Nickel-chromium copings produced using the ribbon sprue demonstrated excellent metal flow and complete mold filling. The castings showed minimal defects, and margins exhibited accurate adaptation to the abutment structures, with no visible fractures or porosity under visual and microscopic inspection. The ribbon sprue configuration enhances the quality of nickel-chromium casting by promoting even distribution of molten metal and reducing the likelihood of common casting defects. This technique provides reliable outcomes in fixed prosthodontic restorations.

**Keywords:** Nickel-Chromium Coping; Ribbon Sprue; Centrifugal Casting; Marginal Fit; Dental Prosthetics

## 1. Introduction

In dental restoration procedures involving metal casting, the sprue functions as a guiding pathway that directs molten alloy into the mold chamber with controlled precision (1). Proper sprue design is crucial to ensure complete mold filling and to minimize casting defects, particularly in the fabrication of metal copings, which serve as substructures placed on prepared teeth to support crowns and bridges (2). The shape, length, angle, and diameter of the sprue directly affect the dynamics of molten metal flow. Undersized sprues can restrict flow and result in incomplete castings, while oversized sprues may cause uncontrolled flow and turbulence, increasing the risk of casting errors (3,4). Hence, optimizing sprue dimensions and positioning is necessary to avoid common issues such as porosity, shrinkage, and poor marginal adaptation (5,6). The ribbon sprue, noted for its broad and flattened profile, enhances the entry zone for molten metal and encourages consistent and even distribution within the mold structure (7). This shape supports faster mold filling, reduces turbulence, and lowers the risk of casting defects, making it a promising alternative to traditional round sprue designs (8,9). Moreover, correct placement of the sprue branches can help avoid uneven distribution of molten metal and minimize heat loss during casting (10). This case report discusses the application of a ribbon sprue system in the fabrication of nickel-chromium copings and evaluates its effectiveness in improving casting quality.

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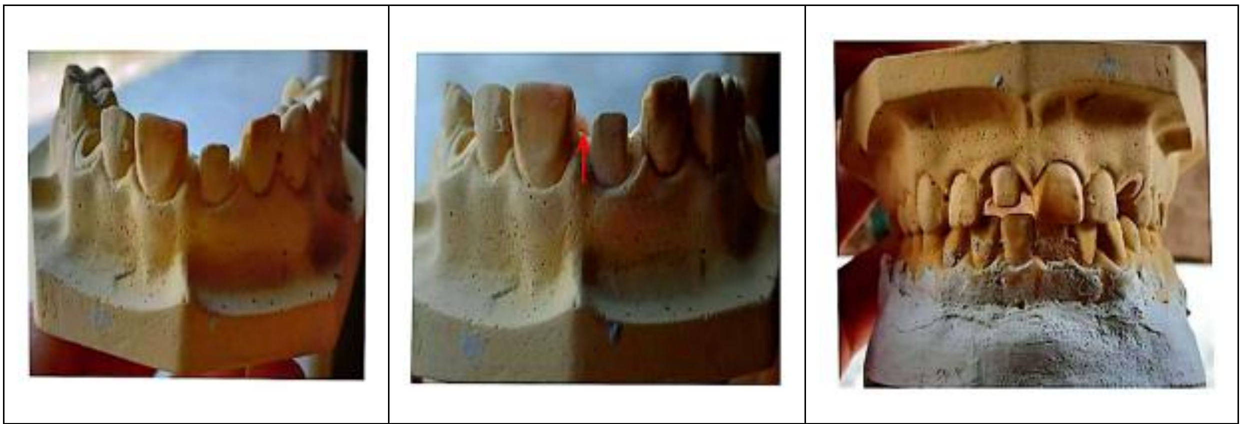
## 2. Case Report

### 2.1. Working Model

A working model was received from dentist. A for the fabrication of a porcelain-fused-to-metal (PFM) crown on tooth 21, which had been clinically prepared. The preparation demonstrated well-defined margins, with a 3 mm occlusal clearance from the antagonist, and clear proximal boundaries. A nickel-chromium coping with a thickness of 0.3 mm was indicated, to be layered with A3.5 shade porcelain.



(A) (B) (C)

**Figure 1** Working model (A), Well defined margin (B), 3 mm occlusal clearance from the antagonist, and clear proximal boundaries, (C)

### 2.2. Laboratory Procedure

The laboratory process began with sectioning the die, placing dowel pins, and adding a gypsum base to stabilize the model. Separator was applied 1–2 mm above the cervical margin, and the abutment was coated with adhesive. A uniform wax pattern approximately 4 mm thick was applied using inlay wax and adjusted as needed. A ribbon sprue was shaped by flattening a wax strip between glass plates, targeting dimensions of 2 mm thickness, 4 mm width, and 2.5 cm in length.

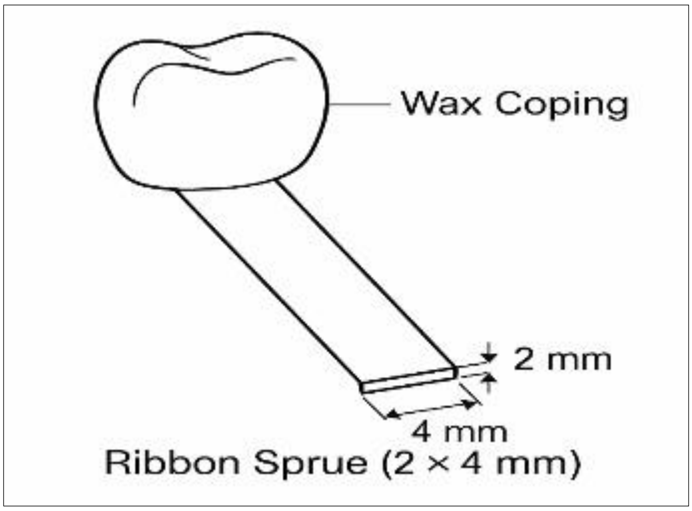



**Figure 2** sketch of ribbon sprue dimensions

To achieve a smooth surface, the sprue was gently reheated with a warm gypsum knife and reshaped. It was then mounted upright into the casting ring, maintaining a height below the ring's edge. Investment material was poured using a high-pour technique to reduce bubble formation, filling the coping mold first before completing the rest of the space. Burnout started at room temperature and was gradually raised to 400 °C, then 700 °C, to maintain dimensional stability.

The heated mold was transferred to a centrifugal casting unit. The alloy was melted using a blow torch, with the flame adjusted to a blue color to ensure clean melting. Once molten, the metal was cast into the mold. After cooling, the mold was divested, followed by sandblasting, finishing, and fitting. Internal adaptation was assessed using red wax to identify pressure spots, which were adjusted until proper seating was achieved. The final coping showed excellent casting integrity.

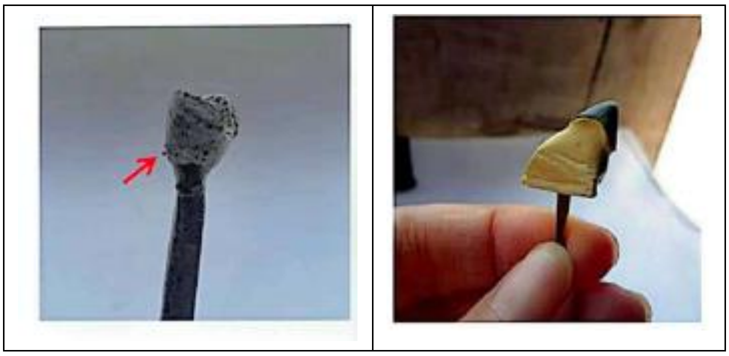


**Figure 3** The mold was divested and the final coping showed excellent casting integrity

No porosity was seen on the labial surface, with no evidence of subsurface porosities or internal bubbles, except for a small void at the inner cervical margin. No fractures were noted, and the coping exhibited full metal fill with satisfactory marginal fit, free from shrinkage-related gaps.

**Figure 4** No porosity was seen on the labial surface, with no evidence of subsurface porosities or internal bubbles

## 3. Discussion

The use of ribbon sprue in the fabrication of nickel-chromium copings demonstrated favorable casting outcomes. Notably, no porosities were observed on the labial surface, and no laboratory failures occurred throughout the process. This is clinically significant, as casting defects such as porosity or fractures can interfere with coping adaptation during try-in and affect the overall success of the prosthetic restoration. Porosity in metal copings can often be addressed by controlled polishing with pink stone abrasives, which allows for the selective removal of superficial defects while maintaining the desired thickness of the coping (11).

In this case, the mesial, distal, palatal, and occlusal surfaces were smooth and consistent in thickness, reducing the need for extensive post-casting adjustments. A minor subsurface porosity was detected at the internal cervical area, likely due to air entrapment during investment pouring. This type of defect often arises when the investment is poured without adequate vibration or when the mix bottle is held too low, resulting in trapped air bubbles (12). However, in this case, the application of a separator followed by adhesive helped minimize internal surface roughness and contributed to better coping adaptation (13). No fractures were detected in the final coping. Fractures are often associated with improper wax pattern thickness or casting errors, where insufficient wax leads to inadequate metal flow and weak spots (14).

The full metal fill achieved using ribbon sprue in this case demonstrates the advantage of a broad and controlled metal flow path during casting. Shrinkage porosity, which occurs as a result of metal contraction during cooling, was not observed. This was likely due to allowing the mold to cool completely post-casting before divestment, a step that helps prevent distortion and internal stresses (15). Furthermore, accurate marginal fit was achieved, emphasizing the importance of proper coping design and alignment with the abutment tooth to avoid open margins (16). Lastly, the mesial-distal spacing and coping thickness must be precisely controlled to prevent impingement on adjacent teeth or excessive bulk, both of which can compromise restoration function and aesthetics (17).

The ribbon sprue system contributed to achieving this balance by facilitating even metal distribution and consistent coping formation. This case contributes to the growing evidence that ribbon sprue systems can improve casting reliability in prosthodontic laboratory procedures and potentially reduce chairside adjustments.

## 4. Conclusion

The use of a ribbon sprue in the fabrication of a nickel-chromium coping for a PFM crown demonstrated favorable outcomes in terms of casting accuracy, marginal adaptation, and defect prevention. Minimal porosity and the absence of fractures indicate that the ribbon sprue facilitated controlled and uniform metal flow during the casting process. By optimizing sprue dimensions and placement, this technique also minimized the need for extensive finishing and chairside adjustments. These findings are consistent with previous studies highlighting the advantages of wider sprue designs in achieving stable flow and reduced casting flaws.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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