High resolution negative silicone rubber impressions of perforation on stone personal elements for technological studies

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ABSTRACT

Although several scientific papers mention the use of HD silicone based impression materials for the study of small perforations, until today there are no published explicit and detailed protocols in this research’s field. This technique is particularly useful in the field of the technological study of prehistoric ornaments, in particular for drilling methods. Unfortunately, the originals are often not suitable to be analysed with the main high magnification methods (they are delicate objects; they cannot be moved; they have several hidden points for direct observation) and require the development of a specific study methodology. To explain the method in detail, we propose a procedure divided into 11 phases, and some intermediate steps, capable to obtain an accurate replica suitable for SEM analysis. This procedure is applied on a Neolithic carnelian bead (hard stone) from Mali (G. Calegari Private Collection, Milan) as part of a scientific research aimed at documenting the technological indicators present on the object and their interpretation. Impressions were taken on the hole on the two faces (hole A and B) and part of the surfaces (surface A and B). Thanks to the very short contact times and the good mechanical characteristics of the used product (HD negative impression silicone) the procedure is a safe, easy, cheap, portable, low-time consuming and very effective, especially in the case of hidden surfaces such as inside of perforations.

EXTERNSAL LINK

https://sites.unimi.it/preclab/progetti/microbeads/

DOI

dx.doi.org/10.17504/protocols.io.bp2ymqfw

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KEYWORDS

Material culture, Archaeology, Jewellery, SEM analysis, Impressions, Silicone moulding
The total time of application of the protocol is approximately 70 minutes.

A few precautions are essential for the safe application of the protocol:

(1) Careful evaluation of the degree of porosity and fragility of the object (Phase 1). Do not use latex gloves to touch the archaeological object or the equipment; (2) the best results are obtained with temperatures between 15-25° C at 50% humidity; (3) protection while working with acetone (use of glasses and mask).

The protocol is based on the direct experience of one of the authors (SV) and from a extensive scientific literature. Below a brief basic bibliography:


Proper application of release agent. The application of at least one layer of release agent is often recommended. In this case, on the basis of personal tests carried out by one of the Authors (SV) on carbonates (marble) and due to the extremely compact nature of the raw material of the object presented in this protocol, it was decided not to apply the release agent (normally polyvinyl alcohol in aqueous solution).
MATERIALS TEXT

List of materials needed:

- Coltene microSystem® (dispenser gun MKII, mixing tip, oral tip, jet bite – cartridge 4 x 25 ml.)
- Silicone type A Coltene Affinis precious, light body
- Precision plastic tweezers
- Distilled water
- Acetone
- Dishwashing liquid (surfactant cleaner)
- Resealable plastic bags (Minigrip™)
- Paintbrush (very fine)
- Toothbrush (soft)
- Metal bowl
- Adhesive Putty (UHU Patafix)

The total cost of materials is about 150 euros
All materials needed

### Preliminary evaluation

**Evaluation phase**

Careful evaluation of the degree of porosity and fragility of the object involved in the mold-making process. In our case it is a compact object, not cracked, made on a hard raw material (carnelian). It is very important to assess whether the surface may be stained by the use of low-viscosity precision dental impression silicones (by reading the scientific literature; carrying out preliminary tests on a small point of the object).

The African carnelian bead (face A)
2 Preliminary cleaning and blocking

2.1 Washing. Holding the piece in your hands, you clean it with demineralised water and then with acetone using a soft, clean toothbrush or cotton (about 3').

2.2 Drying. Leave the piece to dry completely in an open resealable envelope to prevent the dust from settling again (time taken about 30', at a temperature of about 18° C).
2.3 Creation of support and object locking. In our case (broken bead with strongly biconical holes) it is necessary to create an adhesive paste support that blocks the piece and contains the silicone. A release agent layer is not applied because it will be on contact with a hard stone.

The support made on adhesive paste

<table>
<thead>
<tr>
<th>mould-making</th>
<th>8m</th>
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<td><strong>3</strong></td>
<td><strong>1m 30s</strong></td>
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**Pouring phase I**

Working time: 1’

Taking the molds by injection of impression material into the bead drill A and on surface of the object (3 set of drill hole impressions). Gestures: pouring by dispenser gun; ejection of a little amount of mixed fluid (and discard it) from the dispenser to let air out of the tip; completely fill the end of the tip so that the inlet hole is full to prevent an air column from being injected (time taken: 30”).

Citation: Stefano Viola, Matteo Gios, Umberto Tecchiati, Stefano Viola (12/05/2020). High resolution negative silicone rubber impressions of perforation on stone personal elements for technological studies. https://dx.doi.org/10.17504/protocols.io.bp2ymqfw

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3.1 **Drill hole impression A.** In this case, strongly biconical holes, an impression is produced in two stages: first one face and then the other. The pouring starts from the bottom and continues with a circular movement to make the silicone adhere to the walls in the best possible way, continuing to rise in a regular way and remaining in an axial position to fill the voids.
3.2 **Surface impression A.** Spread the silicone by injecting and advancing regularly to prevent air bubbles from forming. Leave the excesses of impression material to facilitate the subsequent demoulding phase.

4 **Hardening phase I**

The hardening (demoulding time of silicone: 2\(^{\text{nd}}\)) of the mixture begins as soon as you start injecting the mixture.

5 **Demoulding phase I**

**Gestures:** To be carried out by hand or without sharp tools (plastic tweezers) according to a continuous and delicate movement.
Pouring phase II

Working time: 1’

Taking the molds by injection of impression material into the bead drill B and on surface of the object (3 set of drill hole impressions). Gestures: after changing the mixer tip and its terminal (oral tip), everything as phase 3, step 3.1 and 3.2 (time taken: 30’).

6.1 Drill hole impression B. Like step 3.1.

6.2 Surface impression B. Like step 3.2.
7  **Hardening phase II**

Demoulding time of silicone : 2’

8  **Demoulding phase II**

Gestures: like in phase 5

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**Examination phase and conservation of impressions**  5m

9  **Observation of molds** by microscope (checking for imperfections, air bubbles, etc.).  4m

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10  **Storage of molds** in resealable plastic bags at room temperature.  1m

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Final cleaning stage of the archaeological object

Removal of any residues of silicone impression material. Any slight halo due to the silicone oil can be removed by washing the piece with distilled water and acetone.

11.1 Washing. Use of paintbrush, distilled water and dishwashing surfactant.

11.2 Rinsing. Use of paintbrush and demineralised water.

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11.3 **Drying.** Leave the piece to air dry completely (time taken about 15', at a temperature of about 18° C).