

BOWL MIXING

Heraeus Education



QUICK GUIDE FOR BOWL MIXING

For some procedures, bone cement is still mixed by hand in a mixing bowl. When doing so, first the monomer liquid of the bone cement is placed in a dish and in a second step the powder is added. The entire contents of a sachet must always be mixed with the entire contents of an ampoule. As soon as both components are in the dish, they are mixed with a spatula for at least 30 seconds with steady stirring.

Note:

- A shiny, runny mix indicates cement is not ready to use (polymerization is still occurring)
- 'Finger test' to determine when to apply (cement should be tack free but can still be kneaded)

Why liquid first then powder?

- Allows for even polymerization
- Safety – the powder covers the monomer liquid minimizing monomer fumes
- Improves integrity of the cement – ability to visualize any glass in the liquid before powder is added



From two components to the finished bone cement: Bone cement is produced by polymerisation

By mixing the PMMA powder and the MMA liquid a chemical process is triggered that leads to polymerisation or crosslinking of the individual molecules. As soon as the components of the bone cement come into contact with one another, the powder absorbs the liquid. The monomers in the liquid are linked to form growing chains of molecules while emitting heat. This leads to a steady increase in the viscosity: from the initial liquid and pasty dough, a solid matrix is formed. At the end of the process there is a completely set bone cement.

The speed of the polymerisation and thus the time until the bone cement is set depends on external factors:

- **Temperature** (the cooler the room, the prosthesis or the bone cement components, the slower the setting process)
- **Humidity** (higher humidity accelerates polymerisation)
- **Type of mixing** (vacuum mixing accelerates polymerisation)

‘The bone cement is the only implant that we manufacture ourselves.’ Professor Rudolf Ascherl

Varying surgical conditions can also affect the polymerisation. Therefore, the experience and expertise of the users play an important role in being able to estimate the right time for the application and setting of the bone cement. Ultimately, the medical device bone cement is produced during the mixing process in the operating theatre.

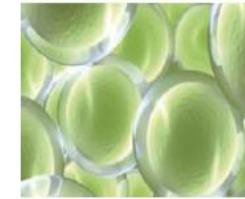
Time of application

The application of the bone cement on the prosthesis or the bone should be carried out as soon as the surface of the bone cement is tack free but can still be kneaded. The ‘finger test’ is used for checking. As a rule, the final setting takes place in the body of the patient.

The polymerisation of the bone cement occurs in four consecutive phases: mixing phase, waiting phase, working phase and setting phase. This sequence is characterised by an increase in the viscosity of the bone cement dough up to complete setting.

1. Mixing

The chemical reaction starts as soon as the monomer liquid penetrates the surface of the polymer beads of the PMMA powder. The mixing leads to a uniform wetting of the powder with the liquid so that a homogeneous, dough-like mass is produced. The mixing time is 30 seconds unless recommended otherwise.



*PMMA powder
before wetting
with the monomer
liquid*

Mnemonic for PALACOS® bone cements: 'The snowflakes fall on the lake'

Because both components immediately react with one another upon contact, the liquid is first placed in the mixing device and then the entire package of powder is added. The mixing process should then start immediately.

2. Waiting

Immediately after the mixing, the bone cement will be stringy and sticky; subsequently the cement dough becomes increasingly solid, that is, viscous. This is because monomer molecules connect to form longer and longer chains that are also linked at various points to form a network.



Chain formation

3. Applying

As soon as the bone cement no longer forms threads and is tack free, its actual use in the body of the patient starts: the bone cement is applied to the bone. Finally, the prosthesis is fixed in the bone cement. Excess bone cement that is forced outwards by the insertion of the prosthesis must be removed while it is still soft. The cement will also continue to become firmer during the application. For this reason, there is a limited window of time available for the working that varies depending on the type of cement and external conditions (e.g. temperature). The working phase ends when the cement can no longer be kneaded.



Completion of the chain formation

How long can the bone cement be worked?

To identify the end of the working time, it is recommended to prepare a cement sample in the form of a small disk about 3–5 mm thick (corresponding to the bone cement mantle of the prosthesis). As soon as the bone cement disk no longer sticks, the bone cement must no longer be used. This sample should not be kneaded to prevent a transfer of energy that would accelerate the setting.

4. Setting

During the setting phase a thermal reaction takes place: the bone cement paste heats up and sets. During this phase the bone cement cannot be shaped. The prosthesis must be pressed against the bone cement until the bone cement has completely set.



Homogeneously set bone cement

