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TECHNICAL NOTE

Negative pressure suction technique for bone cement introduction into the delivery syringe
A technical note

Philip LEIJSSEN, Emmanuel THIENPONT

From Saint Luc University Hospital-UCL, Brussels, Belgium

The authors present in this brief note a technique to facilitate the introduction of high viscosity bone cement into a cement syringe for retrograde high pressure cementing during total hip or revision knee arthroplasty.
The nozzle part of the syringe is connected to the suction device used intra-operatively, to achieve a negative pressure in the syringe. Introduction of the cement into the syringe is thus greatly facilitated, which saves time during the curing process.

Keywords : acrylic cement ; syringe ; arthroplasty.

The success of cemented total hip arthroplasty has been extensively documented (*1,2*). The long term survival has been increased with third generation cementing techniques (*1,2,5,6*). These usually consist of performing adequate bone preparation and cementing under pressurisation (*5,6,8*). Several delivery systems exist for distal and retrograde cement application under pressure (*5,6*). If these systems are used in conjunction with vacuum mixing, in general the cement is already present in the cartridge (*6-8*). However for economic reasons such bone cement systems cannot always been used (*6,7*). Hand mixing is a good alternative but requires optimal time management, as the cement progressively hardens and the time available for its preparation and injection is limited (*7*).

TECHNICAL NOTE

The authors present a simple, cheap and efficient technique to facilitate and accelerate the introduction of bone cement into a third-generation cementing syringe. After hand mixing of the cement in a bowl, the difficulty consists in introducing the cement in a doughy state into the cement syringe without wasting too much time during the curing process. The syringe is manually stabilized in the upright position. The nozzle of the syringe is connected to the suction device used during surgery, which results in a constant aspiration force and a constant drag on the bone cement. The bone cement already inserted in the syringe is drawn to the bottom and less vigorous movements (lower velocity) are needed to insert the successive doses to fill the syringe.

■ Philip Leijssen, MD, Orthopaedic Surgeon.
■ Emmanuel Thienpont, MD, Orthopaedic Surgeon.
Department of Orthopaedic Surgery, Saint Luc University Hospital, Brussels, Belgium
Correspondence : Emmanuel Thienpont, Orthopaedic Department, Saint Luc University Hospital, Avenue Hippocrate 10, 1200 Brussels, Belgium. E-mail : ethienpont@yahoo.com

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Fig. 1. — Conventional technique used for cement introduction into the delivery syringe.

Fig. 2. — Installation with the syringe nozzle connected to the suction device.

Once all the bone cement has been introduced into the syringe, suction is disconnected and the syringe is introduced into the injection gun.

DISCUSSION

The success and long time survival of cemented total hip arthroplasty (THA) has been well documented (*1,2*). The cement mantle achieved with the cementing technique is of primordial importance for the long-term survival of the implant (*5,6,8*). Various cementing techniques have been utilised ; the injection of a high-viscosity cement through a cement syringe has proven its superiority (*5-8*).

Vacuum mixing systems have been developed, with which the bone cement is mixed directly in the delivery syringe, but they are expensive in comparison to hand mixing, without a clear benefit with respect to the cementing quality (*7*). Hand mixing is a good alternative, but requires a good time management as the cement progressively hardens, and the time available for its preparation and injection is limited (*7*).

In a clinical setting, introduction of bone cement in a syringe is a complex task, as part of the cement is retro pulsed out of the syringe while inserting successive doses (*4*). Bone cement is a complex fluid with rheological properties that vary over time, with handling technique, that are temperature dependent and also relate to other factors (*3,4*).

The conventional introduction of the bone cement into a syringe, using repetitive movements with a spatula, can be interpreted by the laws of physics as a succession of rapid accelerations and decelerations of the mixture being manipulated by the spatula in a cylindrical tube (*3,4*). Principles of rheology state that viscosity (resistance) increases when accelerating while the slower mixture alongside the spatula retains its original 'low-velocity' viscosity (*3,4*). Furthermore, as fluid passes through a cylinder a drag force is generated at the liquid-wall interphase, which depends on the viscosity and the squared velocity of the fluid (*3*). The result of these forces are that the cement comes out again between successive applications and that more and more force and faster and faster movements are necessary to fill the syringe (*3,4*).

With the suction technique presented, the cement is pulled down into the syringe, thus facilitating the cement introduction.

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