Optimal Cementing Technique – The Evidence: What Is Modern Cementing Technique?

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Summary

This chapter gives an overview of cementing technique evolution and defines the current status of modern cementing techniques. Modern cementing techniques aim to improve the mechanical interlock between bone and cement in order to establish a durable interface. The use of distal plug, cement gun, pulsatile lavage and cement pressurising devices have been shown to significantly improve long-term outcomes.

Evolution of Cementing Techniques

Cement Application

In the first decade of cemented THA, cementing techniques were fairly crude (Table 6.1). Femoral canal preparation was done by curetting out cancellous bone. Irrigation – if used at all – was limited, and high viscosity cement was mixed and applied manually. However, it is important to note that even back then, the first form of pressurised cement application was already done by »thumbing« down the cement from proximal to distal. Charnley [13] had already emphasised the importance of achieving adequate cement pressure: »… The cement is forced down the track of the medullary canal as a stiff dough and the insertion of the point of the tapered stem of the prosthesis expands the stiff dough and injects it into the cancellous lining of the marrow space….«. This fact may offer an explanation why excellent long-term results have been achieved with so-called first-generation cementing techniques [24, 36, 39, 44].

Cement Containment and Gun Application

The introduction of a distal intramedullary cement restrictor allowed for cement containment and better pressurisation, which resulted both in improved cement penetration [23, 31] and better clinical outcome [18, 19, 34]. Retrograde cement application via cement gun [18, 19] generated higher cement pressures distally than proximally, a pattern reversed by finger packing [32]. »Sustained cement pressurisation« [27] further improved cement interdigitation [6] and provided a method able to resist the bleeding pressure, necessary to prevent blood
entrapment and to obtain a satisfactory cementing result [1, 8] (chapter 5.1, 6.4).

**Bone Lavage**

A further significant step towards improved cementing technique was the observation that bone lavage prior to cementation aided cement penetration [17, 25]. Both bone lavage and cancellous bone quality [17] were found to be significant factors with regard to improved mechanical shear strength [4].

The combination of distal plug, retrograde cement application via gun and bone lavage constitute the main factors of the improved second generation cementing techniques (see Table 6.1).

**Cement Pressurisation and Pulsatile Lavage**

A further distinction into third generation techniques (see Table 6.1) is probably more of academic and didactic interest, but a further and important evolution of cementing technique was certainly seen with the introduction of pulsatile bone lavage (chapter 5.2) and pressurising devices, which facilitated a more reproducible pressurising technique [11, 27]. Also, standardised vacuum cement mixing and the use of stem centralising devices are considered third-generation techniques. Vacuum mixing of cement has been shown to contribute to the risk reduction for revision in the long term [30]. However, this may not be the case for all cement types (chapter 4). Distal stem centralizers on the whole seem to have clear benefits, as the risk for stem tip to bone contact is reduced, which has been identified as a late failure mechanism due to osteolysis induced periprosthetic fracture (chapter 5.2).

There may be dispute as to whether the use of pulsatile lavage and pressurising devices (chapters 2.1, 2.2) should be labelled second- or third-generation techniques. However, more thorough cleansing of the bone bed by the use of pulsatile jet-lavage has been shown to be significantly more effective than manual lavage [11]. Furthermore, the use of pressurising devices to seal and contain cement at the femur and acetabulum, are proven steps to further improve cement pressurisation and hence interdigitation. The consequent use of pulsatile lavage and the pressurising devices should be considered mandatory parts of modern cementing techniques.

### Impact of Modern Cementing Techniques

Modern cementing techniques aim to improve the mechanical interlock between bone and cement in order to establish a durable interface. Cement interdigitation not only depends on bone preparation, but also on lavage and mode of cement application. Good interdigitation is a product of adequate cement penetration and resistance to bleeding. Another elegant method has been advocated, where bone cement is applied under vacuum suction and femoral drainage [14], to reduce interface bleeding without the downside of intramedullary pressure increase (chapter 15). However, so far no long-term data utilising this technique has been published.

In contrast, both pressurisation and lavage of cancellous bone have been identified to be the most significant factors with regard to improved cement interdigitation [1, 4, 10, 11, 17, 25, 28, 31, 38, 40] and been shown to be also clinically highly effective. Several clinical studies comparing patients before and after the introduction of modern cementing techniques have confirmed the benefit of improved cement application techniques [7, 12, 29, 30, 34, 42, 43, 45]; with the same benefit being found also in young patients [3, 5, 35]. Furthermore, if the risk for revision is taken as the measured outcome, the Swedish Hip Registry has provided important evidence.