In which patients should cemented femoral component be used during primary total hip arthroplasty?

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Response/Recommendation:

The literature supports the use of a cemented femoral component in female patients older than 70 years of age, in patients with femoral neck fractures, in patients with a Dorr type C femur, and in patients with severe osteoporosis.

Level of Evidence: Moderate

Rationale:

A large number of studies from multiple countries have been published on the topic of using cemented femoral stem during total hip arthroplasty, including large database and registry studies, retrospective reviews, meta-analyses, and some randomized controlled trials. Given the multitude of factors influencing the decision-making for using cemented femoral components, each factor has been separately considered when reviewing the literature.

The most studied factors in the literature are age and sex, which consequently have the clearest evidence for cement use. There is strong evidence in the literature suggesting that a cemented femoral component should be used in elderly female patients. Studies have found that cemented femoral fixation results in significantly decreased intra-operative periprosthetic

fractures, post-operative periprosthetic fractures, and revisions in elderly female patients[1–9]. Some studies also demonstrated a reduction in periprosthetic fractures and revisions in all elderly patients, regardless of sex[1,10–18]. However, there is evidence to the contrary also, that suggests that cemented fixation in elderly patients is significantly correlated with higher aseptic loosening rates and other complications such as pulmonary embolism and infection[2,11,16,19,20]. Studies have consistently demonstrated that female sex appears to be an independent risk factor for periprosthetic fracture[3,21,22]. Compared to female patients, the risk reduction effects for cemented femoral components on periprosthetic fracture rates and revision rates appear to be less significant for male patients[1,2,6]. For patients younger than 50-55 years of age, cementation does not appear to provide protection against periprosthetic fractures or revisions and might increase the risk of aseptic loosening and revisions[23–25]. It should also be noted that the definition of "elderly patients" varies significantly between studies with common cutoffs between 65 and 75 years. Given the lack of consensus for age cutoff, it appears that considerations should be given for cementing the femoral stem in patients older than 75 and perhaps older 65 and the presence of poor bone stock [9]. However, the benefits of reduced periprosthetic fractures need to be weighed against potentially increased risk of aseptic loosening and other complications.

In the challenging setting of hip replacement in young patients with hip dysplasia, some studies have demonstrated that cementless stems exhibited a higher ratio of intraoperative fracture and thinning of cortical bone including stress shielding, medullary changes, stem alignment changes, and osteolysis, compared to cemented stems; further, there appears to be no significant difference in survival at a minimum of 7 year follow-up[26–29]. This is not to say that cementless stems should not be used in these patients, but in the setting of challenging

torsional deformities, cemented stems may be a reasonable alternative to diaphyseal-engaging stems to help correct these difficult deformities.

There is a large number of studies evaluating cementation of femoral components in total hip arthroplasty specifically in the setting of femoral neck fractures, with the literature overwhelmingly supporting the use of cemented femoral components in this population. Studies have shown that cementation of the femoral component in this setting significantly decreases the rates of periprosthetic fractures, complications, revision rates, and significantly increases patient-reported outcome measurements such as the Harris Hip Scores[30–37]. Notably, there were two randomized controlled trials evaluating cement usage in this population; early discontinuation of both trials was due to preliminary results demonstrating significantly increased complication rates (peri-prosthetic fractures, revisions, and dislocations) in the uncemented group[30,31].

Regarding patients with radiographic osteoporosis or Dorr Type C femoral anatomy, one prospective study showed significantly increased periprosthetic fracture rates (22% for Dorr C vs 2% for Dorr B and 0% for Dorr A, $p < 0.0001$) when using cementless stems[38]. A multi-center retrospective study of patients with acute femoral neck fractures who underwent THA demonstrated that Dorr C femoral bone quality was associated with increased risk of periprosthetic fracture (OR 5.53, $p = 0.001$) while using cemented stems significantly decreased the risk of periprosthetic fracture (OR 0.03, $p = 0.02$) [39]. Regarding metabolic bone disease, the literature suggests that osteoporotic patients undergoing THA have higher risks of periprosthetic fractures, and cemented femoral component in osteoporotic patients is correlated with better patient-reported outcomes and lower revision rates[21,40,41]. However, there is some disagreement in the literature with one large database study showing similar rates of periprosthetic fractures and revisions in osteoporotic patients with cemented vs cementless

femoral component[42]. Overall, high quality studies regarding cement usage for Dorr C / osteoporotic patients are lacking, which is likely in part due to patient selection bias given the general consensus of using cemented femoral components in these patients.

It is of key importance to acknowledge the grade of technical complexity that cementing adds to the surgery, and given the growing evidence that supports its use in certain cohorts, it is critical that we, as surgeons and investigators, understand the fundamentals and evidence underlying cement properties such as: thermal considerations, viscosity, porosity, antibiotic-impregnation, timing, as well as the modern cementation techniques (stem designs, canal preparation, restrictors, centralizers, vacuum mixing technique, mantle thickness, and pressurization) [48,49]. It should be noted that there is always a risk of bone cement implantation syndrome (BCIS) and pulmonary embolism when using cemented femoral components[43,44]. Although the incidence of severe BCIS is low, it could cause significant mortality and morbidity for patients, especially for elderly patients with co-existing conditions[44,45]. Additionally, cement usage will also inevitably add additional time to the operation [46]. New-generation triple-taper collared cementless femoral components have shown promise in significantly reducing the periprosthetic rate after primary THA compared to collarless stems, but further research is warranted in this domain and particularly in comparison to cemented stems [47]. Careful consideration of numerous factors should be made when deciding between cemented versus uncemented femoral components in light of the above evidence.

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