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Bone preserving techniques for explanting the well-fixed cemented acetabular component

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ABSTRACT

Background: Removal of a well-fixed, cemented acetabular component at the time of revision hip surgery can be complex. It is essential to remove the implant and cement mantle in a timely fashion while preserving bone stock and osseous integrity. The biomechanical properties of polymethylmethacrylate cement and polyethylene can be utilised to aid with the removal of well cemented implants which are often harder than the surrounding bone. While removal of loose components may be relatively straightforward, the challenge for the revision arthroplasty surgeon often involves the removal of well-fixed implants. Here, we present three established techniques for the removal of a well-fixed cemented acetabular component and one novel modification we have described before.
Method: We collate and review four techniques for removing well-fixed cemented acetabular implants that utilise the different biomechanical properties of bone cement and polyethylene. These techniques are illustrated with a photographic series utilising saw bones. A step-by-step approach to our new technique is shown in photographs, both in the clinical setting and with a "Sawbone". This is accompanied by a clinical video that details the surgical technique in its entirety.
Results: These techniques utilise different biomechanical principles to extract the acetabular component. Each technique has advantages and disadvantages. Our new technique is a simplification of a previously published extraction manoeuvre that utilises tensile force between cement and the implant to remove the polyethylene cup. This is a safe and reproducible technique in patients with a well-fixed cemented acetabular implant.
Conclusion: Understanding the biomechanical properties of polymethylmethacrylate bone cement and polyethylene can aid in the safe removal of a well-fixed cemented acetabular component in revision hip surgery. The optimal technique for removal of a cemented acetabular component varies depending on a number of patient and implant factors. This summary of the available techniques will be of interest to revision arthroplasty surgeons.

1. Introduction

Removal of a well-fixed cemented implant may be required due to malposition, infection, dislocation or polyethylene (PE) wear. Removing the implant in a timely and safe manner, while preserving bone stock, is paramount to the success of revision hip surgery. Multiple techniques are available to the revision arthroplasty surgeon. While some techniques involve removing the implant at the bone-cement interface[1,2] others attempt to separate the cup at the implant-cement interface, followed by manual removal of the cement mantle.[3–8] Separation of the PE cup and polymethylmethacrylate (PMMA) can be achieved by utilising differences in the biomechanical properties of each. The PMMA to PE interface has a lower load to failure in tension than it does in compression.[3] Controlled separation of the implant-cement interface under tension can effectively lead to explantation of the acetabular cup. The soft material properties of PE also allow the material to be cut or reamed out.

The technique of extraction can be tailored to individual cases, all of which aim to remove the PE cup and PMMA bone cement in a timely fashion, generate minimal PE debris, retain bone stock and avoid fracture.

1.1. Technique 1: corkscrew extraction

This technique involves advancing a 6 mm drill centrally into the PE cup to the level of the implant-cement interface. A blunt nosed cork-

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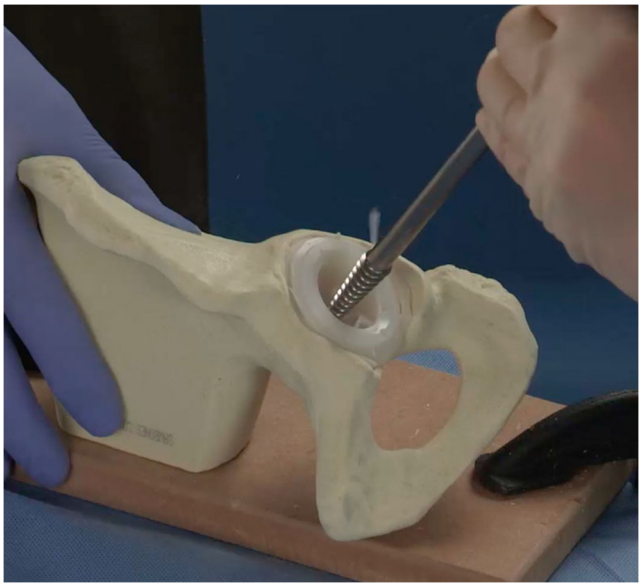

Fig. 1. Introduction of the corkscrew following central drilling.

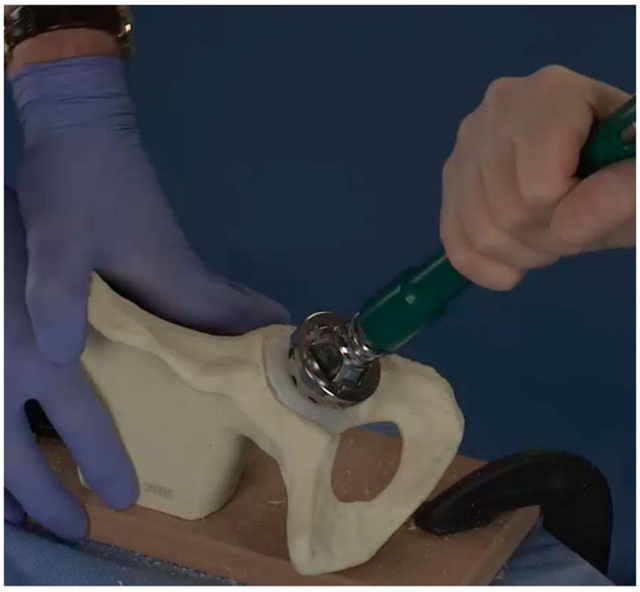

Fig. 2. Reaming of the PE acetabular component.

screw is then introduced (Fig. 1). This technique utilises the discrepancy between the hardness of PE and PMMA. As the corkscrew advances through the PE, it encounters the PMMA. At the implant-cement interface the corkscrew is no longer able to penetrate into the PMMA however further turns of the corkscrew separates the polyethylene from the cement under tension. Distraction occurs at the implant-cement interface and the PE de-bonds from the PMMA. This technique has been utilised in the removal of polyethylene from metal back uncemented cups using the same biomechanical principles.[4] If required, additional force can be applied to the corkscrew once it is engaged in the PE in order to disengage the component from the cement mantle circumferentially.[6,7]

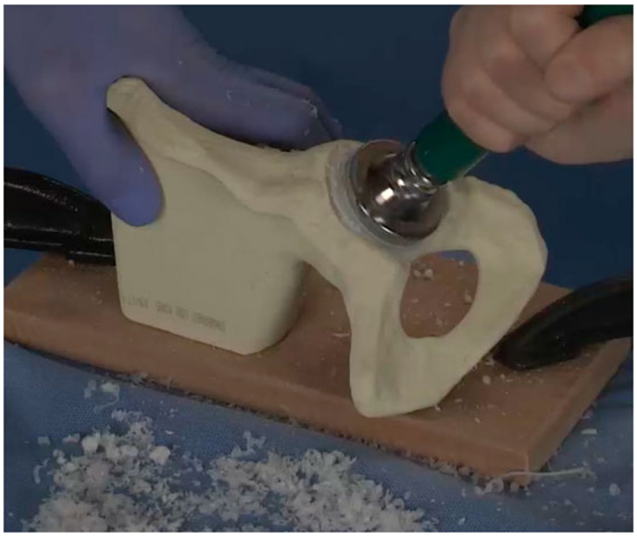

Fig. 3. Polyethylene debris following reaming of the cup.

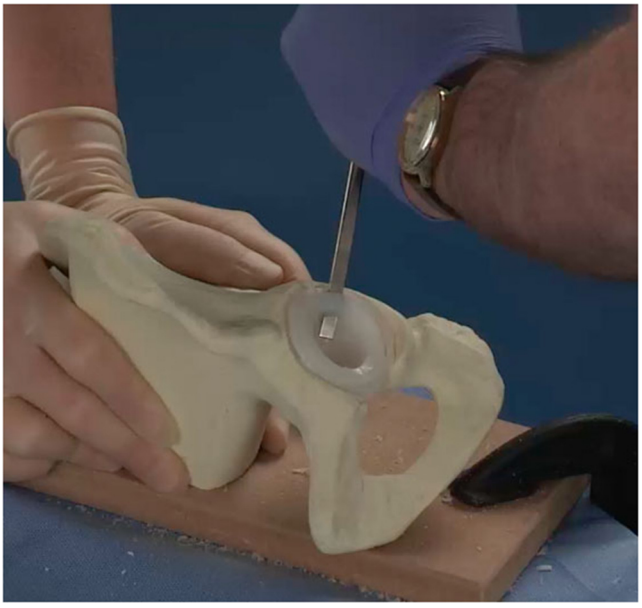

Fig. 4. The cup is quartered, and an osteotome is placed into the PE.

This technique has the advantage of reduced torque force on the PE and potentially reduced damage to bone stock from compressive forces being applied to the bone of the acetabular rim with osteotomes. Care should be taken not to breach the cement mantle or medial wall with the drill. The medial wall once broken by the drill or corkscrew fails to provide a foundation for the distraction, should this happen another technique should be utilised.

1.2. Technique 2: reaming out the polyethylene component

This technique utilises the soft material properties of PE, which makes reaming into the acetabular component possible. Sharp metal instruments cut easily through soft PE, in contrast to cement, which has