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Cemented Dual-Mobility Cup into a Well-Fixed Cementless Metal Shell: A Reliable Option in Musculoskeletal Oncology Patients Requiring Reconstruction.

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Abstract:

Background:
In the treatment of musculoskeletal tumors, many times there are large portions of the acetabulum, proximal femur, surrounding soft tissue, or any combination that require resection. The subsequent reconstruction is an art in itself, fraught with controversy of an ideal reconstruction, especially given the unique nature of one resection compared to another. While "standard" total hip arthroplasty (THA) components are able to serve some of this patient population, a large portion require "nontraditional" constructs. Cementation of a dual-mobility (DM) cup into well-fixed cementless metal acetabular shells has become an increasingly popular option in revision total hip arthroplasty in patients with high risk of dislocations, especially in Europe.[1,2,3] Multiple recent manuscripts are providing quality midterm data that cementation of a DM cup into a previous well-fixed socket seems to be a viable option to treat and prevent instability after revision THA without causing constraint at the cement-cup interface.[1]

Purposes:
This construct is gaining popularity in the United States and its application in musculoskeletal oncology surgeries has yet to be described. This study provides evidence from a single institution that a cemented DM into a metal acetabular shell provides adequate stability despite the issues of increased resection that could lead to instability.

Patients and Methods:
This is a retrospective review of a single institution's experience from three fellowship-trained surgeons of all patients who underwent a cemented DM construct from October of 2017 to June of 2021. We included patients treated primarily or converted to the cemented DM construct. Clinical outcomes were assessed on the bases of complications. Complications of interest included: intraoperative complications, prosthetic joint infection, aseptic loosening, periprosthetic fracture, dislocation, or intraprosthetic dissociation. Radiologic assessment was performed by one of the authors (GYL) based on standardized anteroposterior and lateral x-rays of the pelvis and operative hip. All radiographs following the date of implantation were used for the radiographic evaluation of dislocation. The latest available follow-up radiograph was used for evaluation of aseptic loosening.

Results:
In total, there were 11 patients who met the inclusion criteria. The average follow-up was 1.47 years (17.7 months). Demographic breakdown demonstrated 2/11 (18.2%) of the patient population were female and 9/11 (81.8%) were male. The average age at time of surgery was 66.2 years old (**Table 1**). The most common preoperative diagnoses were radiation-associated osteonecrosis of the femoral head (radiation used in the treatment of metastatic carcinoma lesions) with 4/11 (36.4%) of the patients and pathologic fractures (of the femoral neck or acetabulum) in 3/11 (27.3%) of patients which accounted for a total of 7/11 (63.6%) of the patients between these two diagnoses of this population. Primary THA composed 7/11 (63.6%) of the patients while revision/conversion THA accounted for the remaining 4/11 (36.4%) of the patients.

The constructs on average included a trabecular metal acetabular shell measuring 62.7mm in diameter augmented with 4.8 screws on average to allow for immediate stability and a 48.9mm diameter DM shell was cemented into

the cementless metal shell (**Figure 2**). Two of the eleven patients had additional augmentation in the form of posterior augments or an antiprotrusio cage.

Of all the patients, there was 1 case (9.1%) of prosthetic hip dislocation after a traumatic fall, requiring return to the OR for a closed reduction. There were no cases of intraoperative complications, prosthetic joint infection, aseptic loosening, periprosthetic fracture, or dissociation at the cement-cup interface and none of the patients required revision surgery.

Conclusions:
Cementation of a DM cup into a well-fixed cementless metal shell augmented with screws appears to be a viable option to treat and prevent instability after large hip resections. One of the most critical factor for achieving stability after primary or revision THA is the position of the components, most notably the acetabular cup. Although difficult to assess radiographically, for the one patient who dislocated in this series, some clues can be seen radiographically that may give insight into the cause of her dislocation including an apparent abduction angle of 49.6° which is on the fringe of the "safe zone"[4,5] and spinal hardware from a previous fusion with residual low lumbar scoliosis.[6,7] Given the multitude of indications that may lead to a total hip arthroplasty in a patient with musculoskeletal oncologic pathology, a cemented DM cup into a metal shell appears to be a suitable and effective option.

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PATIENT #	SEX	AGE	COMORBIDITIES	PREOPERATIVE DIAGNOSIS	SURGERY PERFORMED	PRIMARY	REVISION	DATE OF SURGERY	DATE OF LATEST FOLLOW-UP	DATE OF DEATH	FOLLOW UP (YEARS)	COMPLICATIONS
1	M	61	Rheumatoid Arthritis, Right thigh mass	Failed revision THA and TKA (infection)	Right Total Femur Arthroplasty	-	Y	10/12/2017	5/19/2021	-	3.60	None
2	M	50	Metastatic basal cell carcinoma	Radiation osteonecrosis of femoral head	Right THA	Y	-	9/3/2019	12/11/2019	8/12/2020	0.94	None
3	M	73	Metastatic prostate cancer	Pathologic femoral neck fracture (previously radiated)	Right THA	Y	-	9/5/2019	11/30/2020	-	1.24	None
4	M	72	Metastatic melanoma	Pathologic acetabulum fracture with femoral head migration	Conversion left hip hemiarthroplasty to THA with cup/cage	-	Y	9/24/2019	6/4/2021	-	1.70	None
5	F	61	Metastatic breast cancer, C4-7 Spinal cord injury, Pyoderma gangrenosum	AVN vs. Rheumatologic destruction of hip	Left THA	Y	-	11/14/2019	4/29/2022	-	2.46	Left prosthetic hip dislocation
6	M	71	Metastatic prostate cancer	Pathologic femoral neck fracture	Right THA	Y	-	11/21/2019	6/10/2020	9/2/2020	0.78	None
7	F	87	Metastatic breast cancer and Multiple Myeloma	Radiation osteonecrosis of femoral head	Left THA	Y	-	1/21/2020	9/25/2021	-	1.68	None
8	M	58	Multiple Myeloma	Radiation osteonecrosis of femoral head	Right THA	Y	-	2/20/2020	3/1/2021	-	1.03	None
9	M	78	Ischemic heart disease and prostate cancer	Left hip osteosarcoma	Left Revision THA	-	Y	6/25/2020	10/16/2020	-	0.31	None
10	M	71	GCT s/p Left hip hemiarthroplasty	Conversion from hemi to THA for osteolysis	Left Revision THA	-	Y	7/28/2020	3/18/2022	-	1.64	None
11	M	46	Chondrosarcoma	Right acetabular grade I chondrosarcoma	Radical resection of right acetabulum/ilium/superior pubic ramus with navigation assistance and R THA	Y	-	6/10/2021	4/4/2022	-	0.82	None

Table 1: Patient demographics and details about surgeries.

PATIENT #	SEX	AGE	ACETABULAR SHELL TYPE	ACETABULAR SHELL SIZE	NUMBER OF ACETABULAR SCREWS	DUAL MOBILITY TYPE	DUAL MOBILITY SIZE	CONSTRUCT ADDITIONS
1	M	61	Zimmer trabecular metal acetabular revision shell	76	5	Stryker Anatomic Dual Mobility System	58	Zimmer trabecular metal posterior acetabular augment with 5 screws
2	M	50	Zimmer trabecular metal acetabular revision shell	62	7	LINK BiMobile Dual Mobility System	50	-
3	M	73	Zimmer trabecular metal acetabular revision shell	56	5	LINK BiMobile Dual Mobility System	44	-
4	M	72	Zimmer trabecular metal acetabular revision shell	66	6	LINK BiMobile Dual Mobility System	50	Zimmer antiprotrusio cage with 3 screws
5	F	61	Zimmer trabecular metal acetabular revision shell	60	6	LINK BiMobile Dual Mobility System	48	-
6	M	71	Zimmer trabecular metal acetabular revision shell	62	4	LINK BiMobile Dual Mobility System	50	-
7	F	87	Zimmer trabecular metal acetabular revision shell	56	3	LINK BiMobile Dual Mobility System	46	-
8	M	58	Zimmer trabecular metal acetabular revision shell	56	3	LINK BiMobile Dual Mobility System	42	-
9	M	78	Zimmer trabecular metal acetabular revision shell	64	4	Stryker Anatomic Dual Mobility System	48	-
10	M	71	Zimmer trabecular metal acetabular revision shell	62	5	Stryker Anatomic Dual Mobility System	48	-
11	M	46	Zimmer trabecular metal acetabular revision shell	70	5	LINK BiMobile Dual Mobility System	54	-

Table 2: Implant manufacturers and sizing with any additional augmentation.