INTRODUCTION:
Recombinant human bone morphogenetic protein-2 (rhBMP-2) has been proven to increase interbody fusion rates in the lumbar spine. [1] Recently BMP has begun to be used in the cervical spine, especially in the context of multi-level anterior cervical disectomy and fusion (ACDF) and revision surgery. It has been reported that bone graft incorporation occurs in two distinct phases – an initial resorptive phase followed by a bone-forming phase. [2] We recently reported on the characteristics of fusion induction by rhBMP-2 in an absorbable collagen sponge carrier in anterior lumbar interbody fusion (ALIF) with a femoral ring allograft (FRA). [3] When used with a stand-alone FRA for ALIF, the BMP was seen to induce vigorous remodeling of the allograft in the form of early and aggressive graft resorption. When combined with the fact that the majority of axial loading of the spine takes place across the intervertebral space, the grafts became prone to fracture and collapse. In essence, rhBMP-2 initiated the first phase of graft incorporation early and vigorously, destabilizing the fusion construct and inhibiting the second bone-forming phase. Nonunions in ALIF with stand-alone FRA was more common when BMP was used compared to autologous iliac crest bone graft. The purpose of this study was to radiographically analyze the process of fibular ring allograft incorporation and fusion in ACDF and plating surgery with BMP, and to contrast it with the use of allograft alone.

METHODS:
More than forty consecutive patients who underwent ACDF with fibular allograft, rhBMP-2 (InfUSE™), and anterior plating at our institute recently were included in the study. There were 10 single level, 11 2-level, 18 3-level, and 2 4-level fusions (total of 92 fusion levels) at the time of abstract submission. Radiographs and computed tomography (CT) scans at various time points were analyzed and the features of graft resorption and fusion were presented, highlighting the differences from when using allograft without the BMP. Radiographic fusion was defined using the same criteria as in our previously published studies. [4] The follow-up period was up to 24 months, with a mean follow-up of 15 months.

RESULTS:
Remodeling and incorporation of the graft begins earlier and more vigorously with the use of rhBMP-2. The resorptive phase of graft fusion is aggressive, often causing radiographic disintegration of the allograft, but unlike in anterior lumbar interbody fusion with femoral ring allografts, catastrophic failure and instability does not ensue – enough structural support and stability is maintained for the bone-forming phase and fusion to occur successfully. In over 40 patients with more than 90 fusion levels, no pseudarthrosis has been identified in ACDF with plating cases where BMP was used (Table 1). Our published historical controls (ACDF without BMP) show a nonunion rate of 4.5%, 0%, and 18% respectively for single, 2-level, and 3-level fusions. [4-6]

DISCUSSION:
The fusion construct discussed here and the radiographic appearance of the fusion process has features in common with the anterior lumbar interbody fusion construct with femoral ring allograft and rhBMP-2 we reported on recently. However, the fusion rates are superior. This is most likely due to the one major difference between the two constructs – the use of the anterior cervical plate. The plate provides supplemental mechanical stability during the vigorous remodeling process induced by the BMP. In an ALIF with stand-alone FRA + rhBMP-2 construct, nonunion was higher than without BMP because the stability was compromised after rapid resorption of the graft. Thus instrumentation in ACDF with allograft and BMP may have a key role in preventing instability and kyphotic collapse, improving fusion rates – especially in multilevel ACDF surgery.

REFERENCES:

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