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MICROFRACTURE WITH AWLS CREATES SIGNIFICANT SURFACE AND DEEP DAMAGE IN STANDARD SIZED DEFECTS COMPARED TO A NEEDLE MARROW ACCESS DEVICE

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INTRODUCTION

A common marrow access technique for articular cartilage repair is microfracture with conical awls, which requires the creation of holes of increasing diameter as the awls penetrate deeper into subchondral bone. There has been increasing interest in the health of subchondral bone as a key element in cartilage repair[1]. Animal research demonstrates that smaller (1 mm)[2] perpendicular marrow access holes improve the quality of tissue repair. We assessed the effect of standard microfracture awls compared to a novel needle marrow access device on the surface of deep simulated articular cartilage defects.

METHODS

Two types of assessment were performed. In Study 1, circular standardized simulated defects (14, 16, 18, 20 mm diameter) were templated onto a simulated bone block (30lb Sawbones, WA). Six simulated defects were created for each diameter. Simulated defects were treated with either a standard 45˚ Steadman awl (Arthrex) (AWL) or a novel needle marrow access device (SmartShot®, Marrow Access Technologies) by an experienced orthopaedic surgeon to simulate standard clinical practice. The block was scanned and digitally analyzed. In Study 2, 16mm diameter circular chondral defects were created on 4 knees from skeletally mature swine (Midwest Research Swine, Belgrade, MN) and treated with either AWL or SmartShot® tools by an experienced orthopaedic surgeon. Following treatment, specimens were inspected and underwent microCT (XT H 225, Nikon, 58µ resolution) 3D reconstructions were performed (CT Pro3D, Nikon) and analyzed with VG Studio Max to assess depth and width of penetration and effect on subchondral bone.

RESULTS

In Study 1, SmartShot® treated simulated defects had a significantly greater number of access holes while having significantly less surface damage (Figure 1). In Study 2, 16 articular cartilage defects were treated. Grossly, microfracture created wider and more oblique holes. Both types showed marrow elements emerging from the holes (Figure 2). MicroCT demonstrated that AWL holes created significantly more surface (up to 14%) and subchondral bone damage, while SmartShot® holes were significantly narrower, deeper, and had more access to marrow located in inter-trabecular spaces (Figure 3). AWL holes demonstrated bone crushing and compaction, while SmartShot® had minimal compaction of adjacent bone.

DISCUSSION

Standard microfracture awls create large, irregular, and relatively shallow holes with substantial surface and subchondral bone damage in comparison to a narrow gauge device. This may contribute to relatively poor marrow access, pain from crushing of subchondral bone, and may contribute to the failure of microfracture with awls.

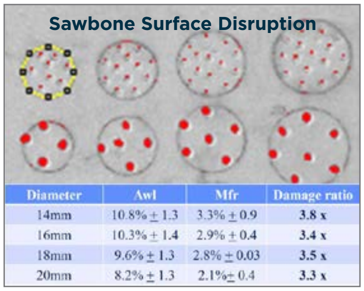
SIGNIFICANCE/CLINICAL RELEVANCE

Use of narrow gauge marrow access tools may decrease subchondral bone damage, which may enhance the quality of articular cartilage repair and may result in better clinical outcomes.

REFERENCES

1. Shimozono et al. AJSM 2018.
2. Orth et al, AJSM 2015.

IMAGES AND TABLES:



Diameter	Awl	Mfr	Damage ratio
14mm	10.8% ± 1.3	3.3% ± 0.9	3.8 x
16mm	10.3% ± 1.4	2.9% ± 0.4	3.4 x
18mm	9.6% ± 1.3	2.8% ± 0.03	3.5 x
20mm	8.2% ± 1.3	2.1% ± 0.4	3.3 x

Figure 1. Comparison of AWL and novel needle marrow access device SmartShot® in Sawbones.

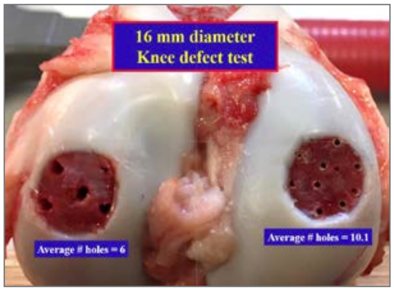


Figure 2. Comparison of AWL and SmartShot® treated cartilage defects.

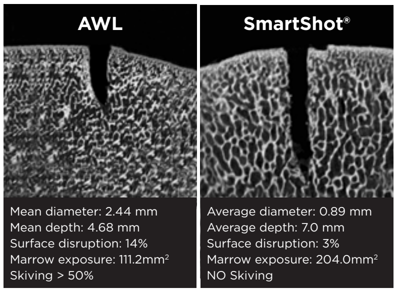


Figure 3. MicroCT comparison of microfracture AWL holes and SmartShot® device holes.