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Dorsal defect on a multi-partite patella: imaging findings

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Abstract Coincidence of dorsal defect on a multipartite patella constitutes a rare cause of anterior knee pain in the first decades of life. Imaging findings of this uncommon symptomatic skeletal variant are discussed, with emphasis on MR features.

Key words Patellar abnormalities · Radiography · CT · MR imaging

Introduction

The dorsal defect of the patella (DDP), the bipartite patella (BP), and the multipartite patella (MP) are well-known abnormalities of the ossification process. They tend to appear during the first decades of life, usually affecting the supero-lateral quadrant of the patella. They may be bilateral, may heal spontaneously, and are usually considered normal skeletal variants. The radiologic appearance has been well described, and the potential to become symptomatic has also been addressed [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13].

Sporadic coincidence of DDP on MP has been reported, and a common etiopathogenic mechanism for both entities has also been suggested [13].

The purpose of our study was to analyze the imaging findings of DDP on MP, both present on the right knee of a symptomatic adolescent. This constitutes a rare association and indeed a very infrequent cause of anterior knee pain for this age group [13]. The MR findings of such association (never described before) are emphasized and their clinical value in the present case is evaluated.

Case report

A 17-year-old boy presented with a 6-month history of pain in the right knee. Pain was exacerbated by long period of standing and exercise. Occasional locking was also reported. Physical examination showed mild tenderness at compression or manipulation of the patella, particularly on its supero-lateral quadrant. No ligamentous laxity was found. Conservative treatment relieved symptoms in 3 months time, and the patient refused posterior follow-up.

A radiographic examination in anteroposterior projection (Fig. 1) revealed a round, well-marginated lucent lesion with faint sclerotic borders at the supero-lateral quadrant of the patella, which also showed a fragmented supero-lateral pole with lobulated contour.

A CT scan (Fig. 2) confirmed the presence of a lytic lesion at the dorsal aspect of the supero-lateral quadrant of the patella, with sclerotic incomplete margins and cortical irregularity on its deepest aspect. Small unfused bony fragments on the supero-lateral pole were also found, and some irregularity adjacent to the syn-

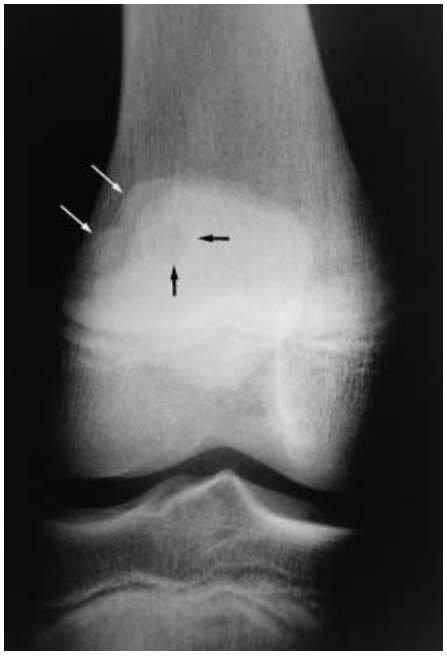

Fig. 1 Dorsal defect an a multipartite patella in a 17-year-old boy. Plain film in anteroposterior view shows a round well-marginated lucent lesion with faint sclerotic borders at the supero-lateral quadrant of the patella *(arrows)*

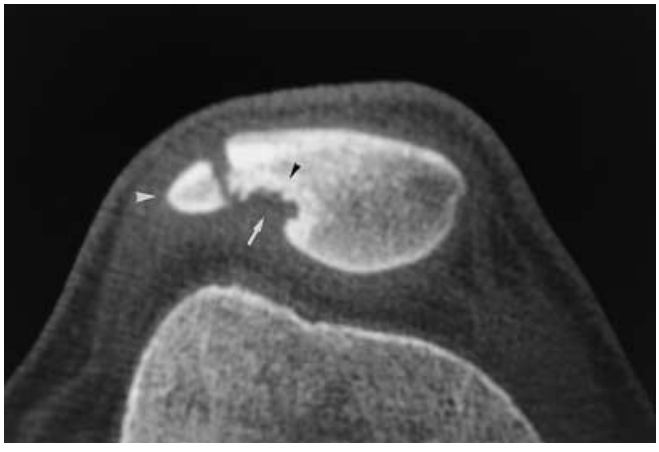

Fig. 2 A fragmented supero-lateral pole with lobulated contour is also seen *(arrows)*. The CT scan shows the lytic lesion at the dorsal aspect of the patella *(arrow)*, with sclerotic margins and irregular surface on its deepest aspect *(arrowhead)*

chondrosis was present; thus, a presumptive diagnosis of DDP on MP was done.

An MR examination was also performed including sagittal fast spin-echo proton-density T2-weighted imaging (TR/TE: 1200/25–85 ms), coronal T1-weighted imaging (TR/TE: 500/12 ms), coronal gradient-echo (TR/TE: 700/22 ms, flip angle 30°) as well as axial 3D gradient (dual-echo) weighted imaging (TR/TE: 26/9 ms, flip angle 40°).

The sagittal turbo spin-echo proton-density weighted imaging (Fig. 3a) showed the dorsal defect as a lytic superficial lesion surrounded by a hypointense rim, which correlated with the sclerotic peripheral reaction shown on plain X-ray and CT. The deepest aspect of the DDP had ill-defined margins, and focal hyperintensity was seen inside.

Coronal T1-weighted spin-echo (Fig. 3b) and T2-weighted gradient-echo imaging (Fig. 3c) clearly showed the coexistence of two different bony abnormalities in the patellar bone. The lytic lesion showed incomplete well-marginated borders, whereas the supero-lateral pole of the patella was composed of two different bony fragments. Thus, initial diagnostic suspicion of DDP on an MP was confirmed. The different signal intensity seen in the bony fragments was initially interpreted as edematous bony changes.

Finally, axial 3D gradient-echo imaging (Fig. 3d) showed compensatory chondral thickening in the supero-lateral quadrant of the patella, which justified the pseudo-edematous changes of the bony fragments seen an the coronal projection. A depression and focal interruption of the chondral surface abutting the cortical defect was also seen. The deepest aspect of the dorsal defect showed mild heterogeneous hyperintensity. The cartilaginous nature of the synchondrosis between fragments and the irregularity of adjacent corticals were also noted.

Discussion

The patella usually arises from a single ossifying nucleus, but secondary centers of ossification may occur, the majority of which being located in the supero-lateral quadrant; these usually fuse to form a single bone, but may remain separate to form a BP or an MP [5]. Similarly to the BP, the DDP is also thought to represent a failure in the ossification process of the patella [6, 7, 8, 9, 10, 11, 12, 13]. Although its precise etiology remains uncertain, a vascular insufficiency has been suggested [13]. In fact, some authors have proposed a common etiopathogenic mechanism for both DDP and BP, in which an anomalous muscle strain from vastus medialis might be involved [13].

Some normal skeletal variants may become symptomatic after repetitive stress, or may even be originated by overuse acting an previously normal bones [1, 2]. Painful BP or MP have been related to the effects of single or repetitive traction forces in the fibrocartilaginous synchondrosis [1, 2, 3, 4, 5, 13], sometimes causing irregularities in adjacent corticals [3]. In symptomatic BP cranial displacement of the supero-lateral fragment has been found either spontaneously [2] or secondary to squatting [3]. Also, lack of articular congruency may precipitate degenerative changes [3, 4].

With regard to the DDP, most patients remain asymptomatic, as the cortical defect is usually compensated by overgrowing articular cartilage [8]. Symptomatic DDP has been associated with cartilage abnormalities, including infolding, chondromalacia, or tear [8, 9, 10, 11, 12], and also with avascular necrosis [13].

Our imaging findings correlated adequately with those previously described in the literature. Plain X-rays

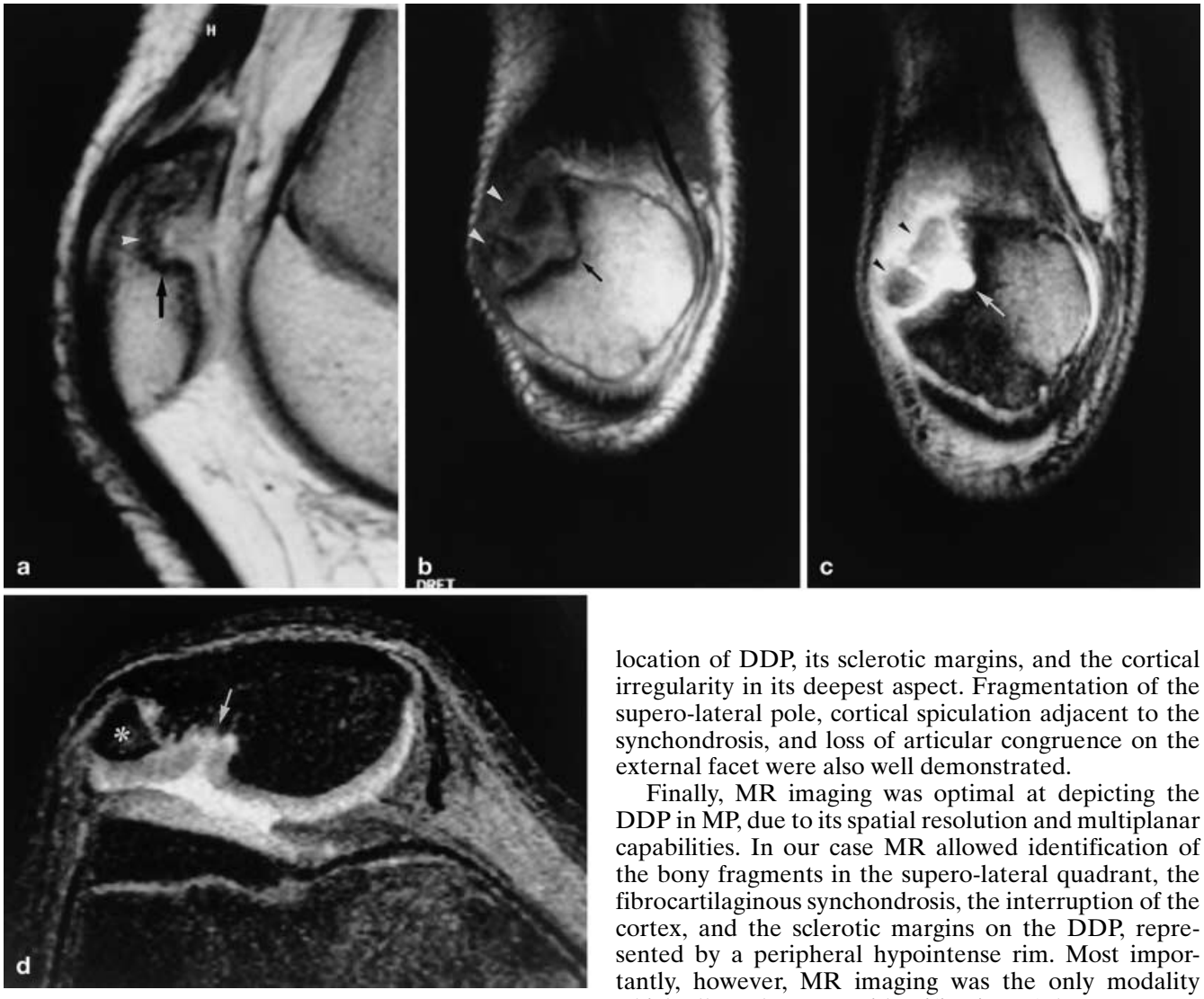

Fig. 3 a–d Unfused bony fragments are also seen *(arrowhead)*. **a** On MR sagittal turbo spin-echo proton-density weighted imaging the dorsal defect shows a well-marginated hypointense rim *(arrow)*, becoming ill-defined on its deepest aspect *(arrowhead)*. Focal mild hyperintensity is seen inside the defect. **b** Coronal T1-weighted SE image and **c** gradient-echo T2-weighted image clearly show the incomplete well-marginated borders of the dorsal defect *(arrows)*, and the fragmented appearance of the supero-lateral pole *(arrowheads)*. **d** Axial 3D gradient-echo image depicts to best advantage the chondral thickening covering the unfused small bony fragment *(asterisk)*. A depression and focal interruption of the thickened cartilage abutting the cortical defect is also seen *(arrow)*

allowed to identify both the DDP and the multipartite nature of the patella; thus, plain X-rays should remain the technique of choice in the initial evaluation of a painful knee when a patellar skeletal variant is suspected. The CT scan depicted to better advantage the dorsal location of DDP, its sclerotic margins, and the cortical irregularity in its deepest aspect. Fragmentation of the supero-lateral pole, cortical spiculation adjacent to the synchondrosis, and loss of articular congruence on the external facet were also well demonstrated.

Finally, MR imaging was optimal at depicting the DDP in MP, due to its spatial resolution and multiplanar capabilities. In our case MR allowed identification of the bony fragments in the supero-lateral quadrant, the fibrocartilaginous synchondrosis, the interruption of the cortex, and the sclerotic margins on the DDP, represented by a peripheral hypointense rim. Most importantly, however, MR imaging was the only modality which allowed accurate identification of the compensatory thickening of the cartilage, as well as its ingrowth and focal interruption at the region of the dorsal defect. Following previous reports [8, 9], this was useful in identifying this unusual skeletal variant as the source of complaints. Although not found in our case, MR might also prove useful by detecting cranial displacement [2, 3] or edema in the supero-lateral fragment of a symptomatic BP. Edematous changes in other symptomatic accessory bones (such as navicular) have been described in MR imaging [14]. In the case described herein, pseudo-edematous appearance of the supero-lateral pole was originated by the thickened cartilage and the step-off of the articular facet; however, the ability of MR imaging to detect marrow or soft tissue edema may also contribute in identification of an acute symptomatic process.

Imaging findings were so characteristic that a differential diagnosis was hardly pertinent; however, a BP or

an MP should not be misinterpreted as an acute or stress fracture [15]. Also, DDP should be differentiated from osteochondritis dissecans, chondromalacia, intraosseous ganglion, Brodie's abscess, or fibrous cortical defect [8]. Location, sclerotic margins, cartilage changes, and absence of surrounding edema should allow recognition of a true DDP.

Conservative treatment is usually preferred with both BP and DDP [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13]. In the present case, clinical improvement was achieved after 3 months of conservative therapy. In unresponsive individuals, especially in young athletes, a surgical approach may be considered, including resection of the supero-lateral unfused fragments of BP or MP [2, 3, 4, 5] or curettage of DDP [7, 8, 9, 10, 11, 12, 13]. Magnetic resonance imaging may prove useful in surgical planning and follow-up, due to its unique ability to depict chondral abnormalities.

The present study has some limitations. Lack of surgical correlation prevented us from evaluating the nature of the focal heterogeneous hyperintensity found an the deepest aspect of the DDP. Also, lack of follow-up did not allow study of the evolution of clinical symptoms and imaging features.

In conclusion, coincidence of DDP on an MP constitutes a very unusual cause of anterior knee pain in the firsts decades of life. Both conditions share an interesting number of common features, including age, location, natural history, clinical significance, and possibly etiopathogenic mechanism. Different imaging modalities may aid in the study of symptomatic DDP on an MP, but MR imaging should remain the technique of choice when considering chondral lesions, surgical treatment, or follow-up.

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