Editorial

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Negative ulnar variance in our orthopaedic practice

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Editorial

This editorial presents a literature review on negative ulnar variance. It also includes illustrative cases from both children and adults treated in our common orthopaedic practice.

The radius and ulna have nearly equal radiographic lengths. Wrist and forearm position, along with X-ray tube centring, may affect their measurement. Various methods are used to determine the relative position of the distal ulna and radius in adults. However, these measurements are not suitable for immature skeletons, as the epiphyses are not fully ossified. Negative ulnar variance occurs when the distal ulna is shorter than the radius. Neutral ulnar variance is present when both bones' distal articular surfaces align. Positive ulnar variance describes a distal ulna that exceeds the length of the radius. Negative ulnar variance may be acquired, idiopathic, or de novo.[1,2]

Shortening of the ulna may be evident in children with hereditary multiple osteochondromas or exostoses. Forearm deformities may also include ulnar deviation of the wrist, relative bowing of either or both forearm bones, shortening of the forearm (Figure 1), and late dislocation of the radial head. Longer negative ulnar variance causes more radial bowing, a greater radio-articular angle, and a higher risk of radial head dislocation.[3,4]

Figure 1 The radiographs in a child suffering from metachondromatosis, a rare combination of hereditary multiple osteochondromas and multiple enchondromatosis, show pseudo-Madelung deformity, including bilateral negative ulnar variance and increased radial inclination.

Negative ulnar variance may also be diagnosed in children with idiopathic juvenile arthritis. In such cases, premature fusion of the distal ulnar growth plate may play a crucial role in pathogenesis.[5] Physeal arrest following fractures of the distal forearm in children is rare, provided that the treatment principles of growth plate injuries, described by Salter and Harris, are respected.[6] Growth disturbance may be erroneously considered a late sequel of a physeal injury. However, it may be prudent to consider it an event of the initial injury that exhibits a late radiographic appearance. Subsequently, it may be reasonable to include it in a classification scheme of physeal injuries. Therefore, any physeal injury complicated by a post-traumatic physeal arrest or asymmetric growth with or without the creation of a bony bar or bridge was considered a specific type of injury in a new documentation system of distal radial physeal fractures, which were not included in the Salter-Harris scheme (Figure 2).[7]

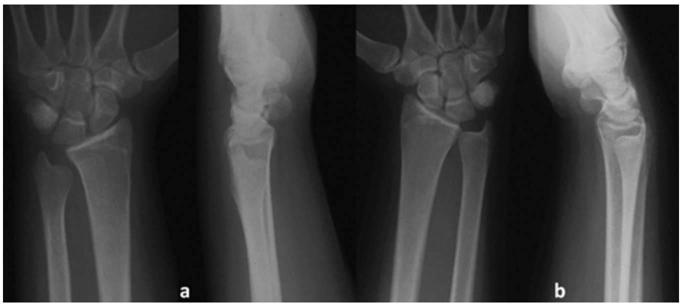

Figure 2 The radiographs in a 14-year-old girl show unilateral negative ulnar variance (a) and the normal side (b). She reported a distal forearm fracture four years ago, which was treated conservatively. The diagnosis is traumatic premature fusion of the distal ulnar physeal plate.

Iatrogenic negative ulnar variance may result from overcorrection of a positive ulnar variance. This scenario arises in patients with physeal arrest of the distal radius or Madelung deformity (Figure 3) treated with distal ulnar epiphysiodesis, ulnar shortening (Figure 4), or radial lengthening osteotomy. Negative variance can also follow excision of the ulnar head in cases of rheumatoid arthritis, Madelung deformity, or post-traumatic dysfunction of the distal radio-ulnar joint.[8,9]

Figure 3 The radiographs in a 14-year-old girl with Madelung deformity show positive ulnar variance, decreased radial inclination, and dorsal subluxation of the distal ulna.

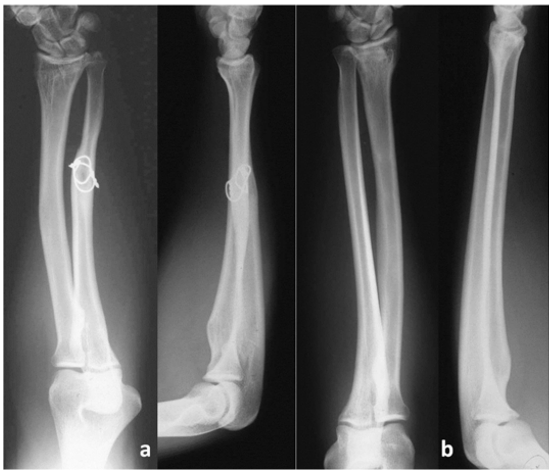

Figure 4 An 18-year-old patient with post-traumatic Madelung-like deformity, including positive ulnar variance and decreased radial inclination. He was diagnosed with distal radial partial physeal arrest after a fracture treated conservatively 10 years ago. The radiographs show healed ulnar shortening osteotomy with no sagittal plane deformity (a) and the normal side (b).

Changes in the length of the ulna relative to that of the radius alter the normal distribution of compressive forces through the wrist joint. In positive ulnar variance, there is an increase in the loads transmitted through the ulnar side of the wrist, leading to ulnar impaction syndrome.[10] The consequences of negative ulnar variance are increased load and shear stresses on the radial aspect of the lunate. The latter may explain the high incidence of negative ulnar variance in patients with Kienböck disease. The wide variety of Kienböck disease synonyms, such as avascular or aseptic necrosis, osteonecrosis, osteochondrosis, lunatomalacia, osteochondritis, traumatic osteoporosis, and osteitis, is due to its uncertain aetiology.[11]

Regarding its pathogenesis, Kienböck disease was initially considered the result of repetitive trauma to the lunate due to occupational activity. However, numerous articles have highlighted that it typically occurs in the 'at-risk' patient, in the 'at-risk' aspect of the proximal condyle of the 'at-risk' lunate, since genetic, anatomical, vascular, and metabolic associations have been identified. The Lichtman classification for Kienböck disease describes the radiographic progression of the lunate's lesion and the degeneration involving the wrist (Figure 5 & 6).[12]

Figure 5 The radiographs of a patient with Kienböck disease show severe collapse of the lunate and reduction of the carpal height. The scaphoid signet ring sign is evident on the anteroposterior view, and the radioscaphoid angle is >60° on the lateral view.

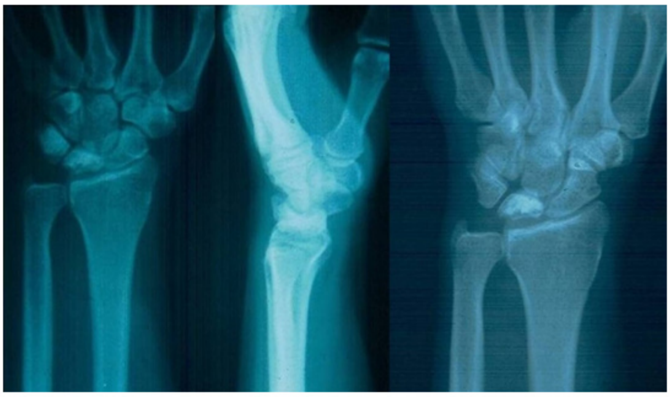

Figure 6 The radiographs in a patient with Kienböck disease show increased lunate density and collapse, decreased carpal height, and proximal migration of the capitate. The narrowing of the radio-scaphoid joint space, with cyst formation and osteophytosis, indicates scapholunate dissociation. On the anteroposterior view, the scaphoid signet ring sign shows scaphoid flexion, while the lateral view indicates a radio-scaphoid angle of 60°.

Infantile and juvenile avascular necrosis of the lunate is a rare entity (Figure 7) different from Kienböck disease. The prognosis is good after immobilization alone in children under 12. The outcome appears better than in adults, although surgery, probably radial shortening osteotomy or an attempt at revascularization, may be required with persistent symptoms in older teenagers.[13,14]

Figure 7 The radiographs in a 12-year-old boy show flattening of the lunate and a radio-scaphoid angle of 60°.

In 1982, a study examined anatomic variations in ulnar and radial lengths in a Greek population. The results indicated that the neutral ulnar variance type was more common (51.7%) than the minus variant (33.6%). Functional disturbance from the latter was found to be minimal.[15] Another report, in 1985, found negative ulnar variance in 21% of 203 asymptomatic wrists. The deformity was observed with an increased incidence in patients with carpal ligamentous instabilities.[16] Other authors have suggested that cases with an idiopathic minor negative ulnar variance could be underdiagnosed as congenital ulnar longitudinal deficiencies, which is an unproven view.[17]

Negative ulnar variance is a predisposing factor in the development of the ulnar impingement syndrome. It is caused by the ulna impinging on the distal radius proximal to the sigmoid notch (Figure 8). Patients may complain of a painful, clicking wrist and a weak grip. Clinical examination reveals a narrow wrist with pain on compression of the radius and ulna and on forced pronation and supination of the forearm. Radiographs typically show a shortened ulna that ends proximal to the sigmoid notch of the radius, and radial scalloping (erosion) with a sclerotic border (Figure 9). Such cases may be finally complicated by a painful and disabling pseudarthrosis.[18,19]

Figure 8 A 30-year-old female with asymptomatic bilateral ulnar impingement syndrome incidentally diagnosed after a wrist injury. The radiographs show abnormal rotation of the ulna with the ulnar styloid overlying the central portion of the distal ulna on the injured wrist (a) and the contralateral side (b). The scallop sign is evident on the magnetic resonance view. The diagnosis of rheumatoid arthritis was examined and excluded.

Figure 9 Bilateral ulnar impingement syndrome in a 62-year-old female with unilateral symptomatology. Computed tomography shows a shortened ulna, scalloping, arthritic changes along the ulnar margin of the distal radius, and osteophytes in the ulnar seat.

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None.

Conflicts of interest

The author declares that there are no conflicts of interest.

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