ANNOTATION

Does shortening of the first ray in the treatment of adolescent hallux valgus prejudice the outcome?

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In 1935 Morton showed that all metatarsal heads make contact with the floor in normal stance, with loss of the distal transverse metatarsal arch when bearing weight. As a hallux valgus deformity develops, the first metatarsal pronates, dorsiflexes and subluxes medially from the sesamoids. The degree of increase in pronation is directly related to the widening of the intermetatarsal angle. Thus the hallux valgus deformity is three-dimensional. As it occurs, the first ray becomes defunctioned so that the ground reaction is transferred to the more lateral rays, particularly the second metatarsal, which has less mobility at its tarsometatarsal joint than is found at the first tarsometatarsal joint. Clinically, this is easily confirmed when one examines the plantar pad of such cases. In severe deformity, calllosities are present beneath the second and third metatarsal heads, confirming the load transfer from the first ray. Even in lesser deformities this skin change may be present. Some patients have synovitis of the second metatarsophalangeal joint because of repetitive overloading of the plantar plate. If the second metatarsal is longer than the first, the second is further overloaded, but only as the heel rises near the end of the stance phase. Therefore, the three-dimensional deformity of hallux valgus, tarsometatarsal stability and the length of the first ray with respect to the second, are fundamental to understanding the biomechanical abnormalities associated with the deformity of hallux valgus.

The debate continues concerning the best type of metatarsal osteotomy for the correction of hallux valgus in the adolescent, as demonstrated in recently published correspondence (the letters of Jones and Robinson). Whether the condition involves an adolescent or an adult, these biomechanical principles and concepts can be applied to the majority of deformities. In adolescent hallux valgus there are some notable exceptions because some presentations will be because of congenital deformity. The most common of these is hallux valgus interphalangeus, where there is a deformity of the proximal phalanx of the hallux. On an anteroposterior weight-bearing radiograph this is shown by the base of the proximal phalanx not being parallel to the condyles of the interphalangeal joint. When present, this deformity is best corrected by a phalangeal osteotomy, usually in the form of a medial closing wedge. The other deformity particular to adolescents involves a grossly abnormal distal metatarsal articular angle where the distal metatarsal articular surface is rotated laterally. Attempts to release this joint laterally and plicate medially will render the joint incongruent, and so the whole joint must be rotated medially to realign the articular surface.

Correcting these deformities at the site of origin is a basic principle of orthopaedic surgery, and any other method would produce a spurious correction. An osteotomy which produces shortening of the metatarsal while correcting these deformities will change the biomechanics of the forefoot and the function of the first ray. Closer examination of the contributing parts of the deformity have led to a better understanding of the treatment options in recent years, resulting in a number of treatment algorithms. During the last century, many osteotomies were described for the correction of hallux valgus, giving the impression that one osteotomy would be a ‘cure-all’. It is now clear this view was mistaken.

Modern orthopaedic surgical techniques aim to correct deformity at the site of origin and recognise the biomechanical abnormality within the weight-bearing foot, with the intention of restoring normal forefoot loading. The majority of adolescent hallux valgus deformities are similar to those of adults, but they present earlier, and so the pathogenesis essentially causes the first ray to become increasingly incompetent or insufficient, transferring forefoot loading laterally. Any osteotomy which shortens, or risks shortening, or produces dorsiflexion/dorsal translation, cannot correct the primary deformity, and rather cre-
ates another deformity. This will result in further transfer of load, potentially rendering an asymptomatic callosity (transfer lesion) symptomatic or worsen an existing symptomatic lesion. This has been reported with a long follow-up. The reason this occurs is because of elevation of the first metatarsal head in mid-stance, because as the metatarsal shortens it moves dorsally as the head migrates along the axis of the first metatarsal, which has a pitch angle relative to the ground reaction in mid-stance. The second metatarsal is then relatively longer, further increasing load on the second and third rays on heel rise. If the osteotomy is itself unstable it can have an additional complication of moving dorsally, which will further exacerbate the load transfer. Therefore, in recent years there has been a trend towards more stable and sometimes internally fixed osteotomies, such as the distal chevron osteotomy for mild to moderate deformity, and to basal osteotomies such as a proximal chevron for more severe deformities. In the adolescent deformity the distal chevron osteotomy can be adapted to correct any deviation of the distal metatarsal articular angle, by excising a medially-based wedge from the dorsal limb of the chevron. This prevents shortening and, owing to its stability, does not allow dorsiflexion of the distal fragment. If correction of the distal metatarsal articular angle is undertaken (correction of rotation of the head with a medially-based wedge) combined with lateral translation of the head, this is now easily stabilised with modern techniques of internal fixation. However, sometimes shortening is required if there is joint stiffness to increase the range of movement, but this is rarely required in the adolescent. If it is necessary, the osteotomy must be fashioned so that when the translation occurs in shortening, at the same time the metatarsal head must translate in a plantar direction. This principle is observed in the Scarf osteotomy.

Obviously, decisions cannot be absolute, but deeper thought and consideration of anatomy, biomechanics and pathogenesis can guide orthopaedic surgeons to a better understanding of adolescent hallux valgus and its treatment. As a general principle, corrective surgery should be undertaken at the site of deformity; spurious correction cannot restore normal anatomy.

References