The hoof pastern axis and its relevance to soundness

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The hoof pastern axis and its relevance

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When discussing conformation or common lameness issues the expression hoof pastern axis is commonly used by vets and farriers, but what are they referring to and how do you see it?

The hoof pastern axis (HPA) on both front and hind limbs can be assessed when, an imaginary line drawn through the centre of the phalanges is compared to the line of the dorsal wall of the hoof capsule, when viewed from the lateral aspect (Adams, 2002).

When assessing for a correct HPA, the phalangeal axis should be parallel with the dorsal surface of the pedal bone. The dorsal wall of the hoof capsule should be free from flares/distortion, if it is going to be used as an accurate guide (Figure 1).

When assessing conformation in the forelimb it is accepted that the HPA should correspond with the angle of the shoulder 48° to 55° (Figure 2), and that it will be more upright in the hinds by 1° to 5° (Adams, 2002) (Ross & Dyson, 2011).

A straight HPA, means that the movement within the joints will be as efficient as possible for the individual, and the soft tissue will not be placed under additional strain.

A horse may have a straight HPA which is either sloping (less than 47° fore), normal (48° to 55° fore), or upright (greater than 56° fore). This may be breed dependant, for example in a thoroughbred is considered normally to have a more sloping HPA than in a Warmblood. It is common for a horse with a sloping HPA to have a long pastern and conversely an upright HPA is often related to a shorter pastern (Ross & Dyson, 2011).

It should be noted that the stance of the horse can affect the visual appearance of the HPA as it can be altered by shifting the bodyweight, correct stance is when the limb is perpendicular above the foot (Stewart, 2013).

When a straight HPA is not present it will be described as either ‘broken forward/ positive’ or ‘broken back/negative’ (Figure 3). When trimming a horses feet with a less than ideal HPA, a farrier will aim to restore it to ‘straight’ although many factors such as limited hoof growth may prevent that happening. Further correction may have to occur through the application of a shoe.

In the horse with a straight HPA, the limb conformation will determine the height and length of the animals’ natural stride. A horse with upright HPA will have a shorter ‘choppy’ stride and are recognised as being less comfortable to ride, those with a sloping HPA and seen to have a longer smoother stride and are therefore more comfortable for riding (Butler, 2004).

The importance of the HPA goes further than the riders comfort. The mechanical strains placed upon the lower limb differ depending on the angle of the HPA. As a result of these forces the shape of the hoof capsule is closely related to the angle of

the HPA. In the straight HPA with a ‘normal’ pastern length the there is an equilibrium between the extensor and flexor forces within the hoof capsule.

The anatomy of the lower limb allows the fetlock to act as a huge shock absorber and it is supported by very strong ligaments and the tendons. These structures have finite elasticity and can be damaged through excessive sudden load or by repetitive strain (figure 4)

In the horse with a straight HPA and a healthy functioning foot, every structure is able to do as designed and absorb or transfer shock. The external structures are able to absorb shock through compression (frog), expansion (wall) or flattening (sole). The descending body weight is supported within the hoof capsule by the joints and sensitive tissues, then ultimately cushioned by the digital cushion and suspended by the attachment between the sensitive laminae and the hoof wall (figure 5).

In the negative HPA more force is placed on the flexor tendons, which is transmitted as pressure into the navicular region, the horse may try to alleviate this pressure by changing its stance, so that its feet are in front of the perpendicular. The hoof capsule is overloaded in the posterior portion and may crush as a result, this and the change in stance can create a vicious pain cycle creating collapsed feet which are slow to recover, if at all.

In the positive HPA the strain is placed more to the extensor region and although this may not directly affect the horse much, the resulting tearing effect in the dorsal wall of the hoof capsule can start to affect the hoof wall integrity. The lack of load on the heels creates contraction and an atrophied frog. The muscles of the flexors may start to shorten, which can produce a stance where the foot is behind perpendicular.

With a straight upright HPA the hoof capsule tends to be more tubular with a more upright heel (possibly contracted) and often a smaller surface area than the equivalent size of animal with a normal HPA. This smaller more upright foot is less able to absorb concussive forces, due to the lesser amount of soft tissue in the posterior third of the foot and the more upright walls expanding less than a normal foot, the shock is transferred more suddenly to the bone column (Jackman, 2001). In the upright HPA the forces tend to be more concussive than in a horse with a normal HPA, the upright foot is loaded more suddenly than when the normal foot ‘rolls’ into weight bearing. The angle of the pastern and fetlock means that the fetlock will drop less reducing the load taken by its supportive soft tissue structures This leads the animals with this conformation to be more prone to arthritic conditions, splints, sidebone and other soft tissue damage such as corns.

In the horse with a straight sloping HPA the hoof takes more load through the back third, so tends to be flatter in angle with a more developed frog and more rounded bulbs of the heels. The foot tends to expand more and is therefore generally larger than the equivalent horse with a normal HPA. In the sloping HPA the foot lands and bears weight more gradually but the load is taken up by the soft tissue, primarily within the hoof capsule and then by the suspensory apparatus within the fetlock. These animals are more prone to damaging the collateral ligaments within the lower

joints, and also the suspensory ligament. The flexor tendons which are forced round a sharper fulcrum at the fetlock, become more prone to damage and create pressure within the joint (Thompson, 1993). Care is required to ensure that these horses do not develop a negative HPA, growth at the toe of the hoof is likely to create excessive leverage and overloading within the posterior third of the hoof. This pressure in turn is likely to crush the juvenile horn at the heels, exacerbating the condition. A negative HPA also further changes the angle of insertion for the deep digital flexor tendon (DDFT) at the coffin joint, increasing the chance of damage. Excessive shoe length in an attempt to support the soft tissue at the fetlock can crush the heels of the foot further, making the condition worse.

In the horse with a negative HPA the aim of the farrier is to restore this axis without weakening the hoof capsule and causing further problems. The authors chosen route is to place the base (the shoe) where the foot should be and at an angle that the hoof capsule should be at (figure 6), this changes the loading on the horn producing structures of the foot and will therefore improve circulation and change the angle the horn is produced at. The hoof capsule can be dressed to straight horn and further growth controlled, without removing excessive horn and weakening the hoof wall. It is also noted that the horse's stance should improve when shod in this manner. By placing the base where the foot should be the limb is instantly removed of the excessive strain and leverage created by a 'long toe low heel' hoof and by controlling the existing horn (preventing leverage) and encouraging growth at the correct angle the hoof capsule will gradually change to a stronger healthier shape. It should be noted that the frog and digital cushion within the hoof capsule can over time be overloaded and crushed beyond a natural recovery and artificial methods to regain a straight HPA may always be required.

A positive HPA may be the result of a poor hoof care and restored within one trim, or may be a result of stance and soft tissue pain that prevents the horse loading its heels comfortably. This lack of loading manifests itself as further heel growth and the removal of this growth just increases the discomfort. The farriers' role is to ascertain the cause and to try return the HPA to straight if possible (Curtis, 2006). If discomfort is the cause of the poor HPA then the foot can be trimmed to ideal and then artificially returned to an angle which is comfortable for the animal, this allows the foot to function more normally as the heels are maintained to where they should be. If in a younger animal where it is preferable to try and return the limb to 'normal', veterinary assistance with pain relief and appropriate physiotherapy can allow gradual reduction in height of the heels.

When there is a differential between a pair of feet, then the aim should be to treat each foot and limb individually and not to force symmetry upon the limbs, as this will compromise one or both of the feet. It must be noted that dramatic changes in the hoof capsule will transfer load to other structures in the limb, for example, over dressing the heels will transfer load to the DDFT and this will stress the inferior check ligament potentially causing lameness.

In the horse with a straight HPA – regardless of its angle- the role of the farrier is to support the hoof and the limb without trying to change the angle of the hoof capsule

as integral strength will be lost and problems more like to occur. Correct farriery can only address any differentials, it cannot change the conformation of the animal, and the farrier's goal is to support it within its weaknesses.

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Legend for Hoof pastern axis (Equine Health) article

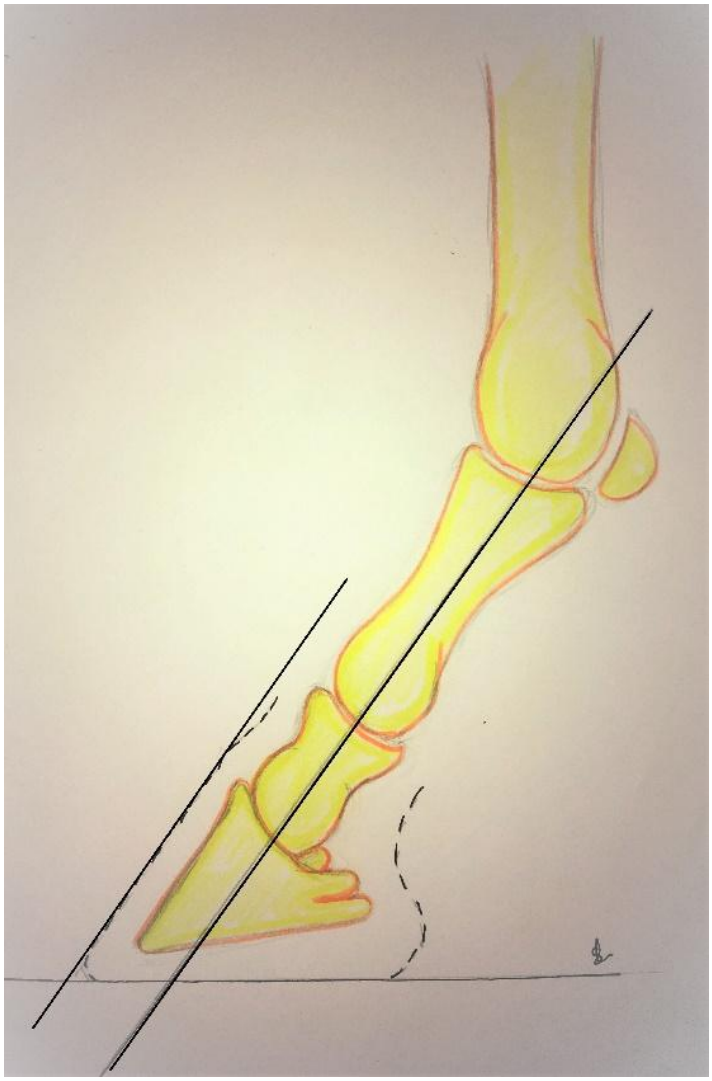

Figure 1: Correct HPA, the phalangeal axis should be parallel with the dorsal surface of the pedal bone. This can be assessed by viewing the dorsal wall of the undistorted hoof capsule.

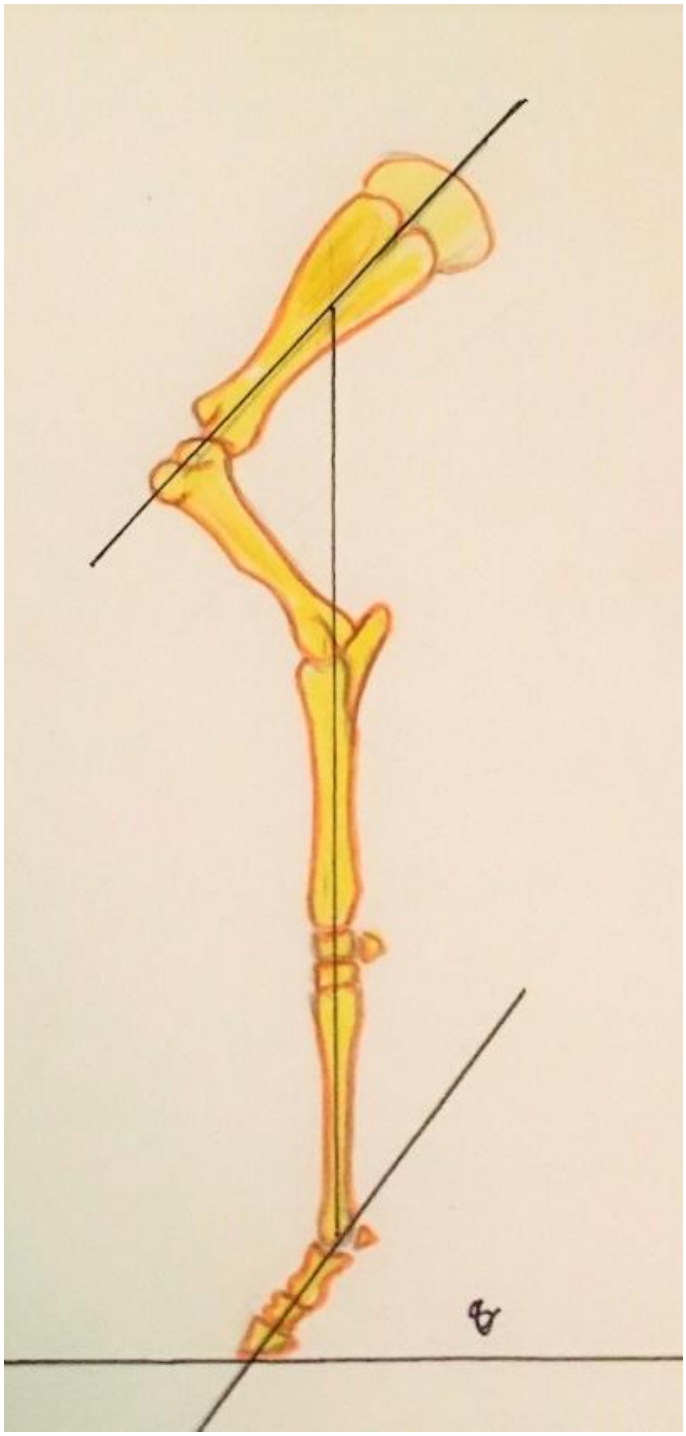

Figure 2: The HPA should correspond with the angle of the shoulder in the forelimb.

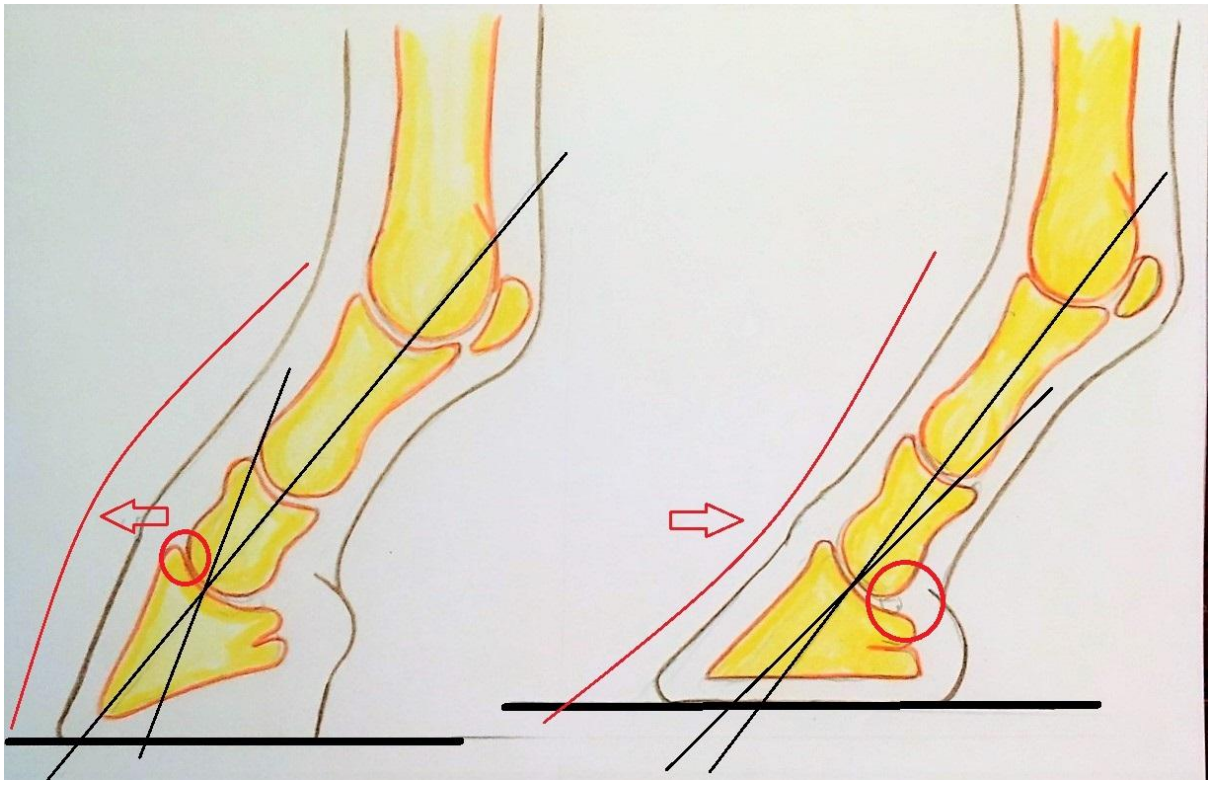

Figure 3: When a straight HPA is not present it will be described as either ‘broken forward or positive’ (on left) or ‘broken back or negative’ (on right), these HPA’s place extra stress on different parts of the distal phalangeal joint - circled.

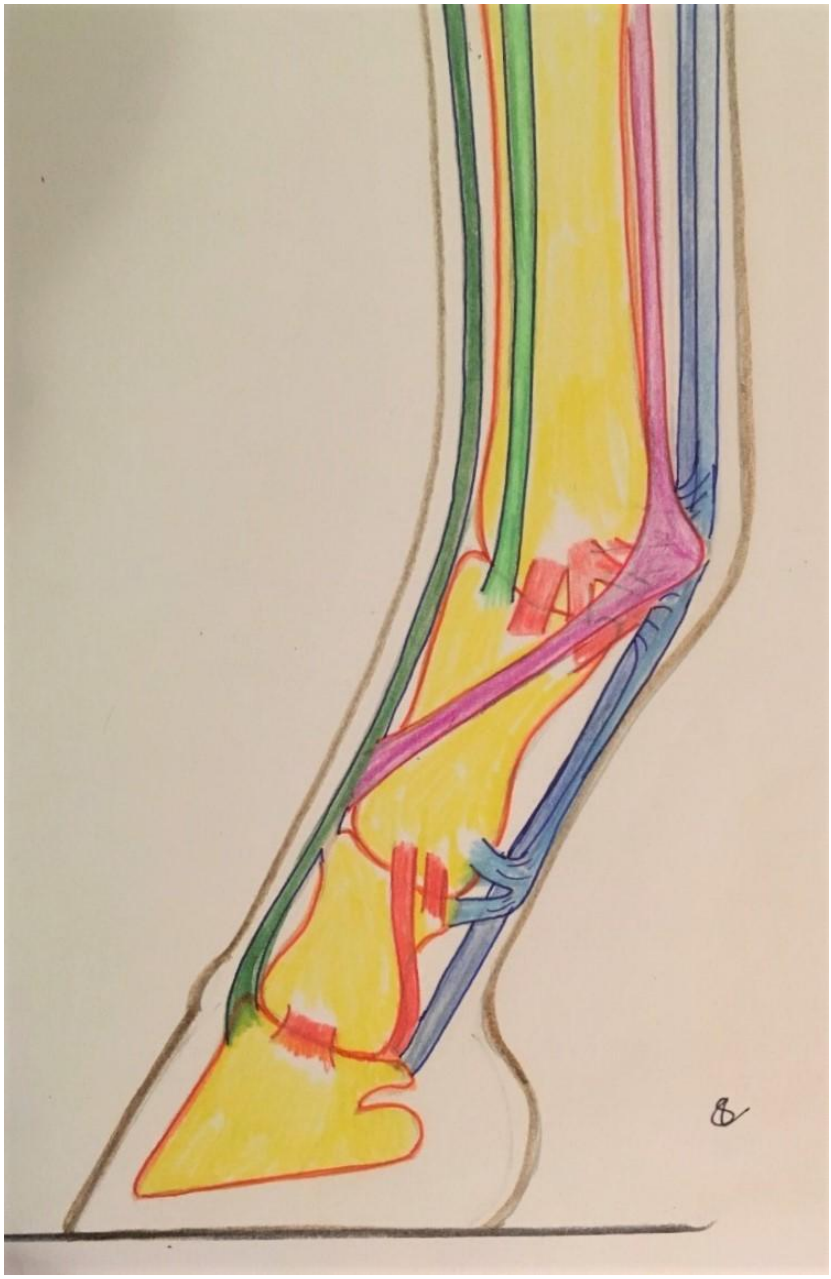

Figure 4: The supporting tissue of the fetlock joint, and the pastern. Extensor tendons (green), the flexor tendons (blue), interosseous ligaments (red) and the suspensory ligament (purple). These structures absorb shock and prevent hyperextension of the fetlock but are subject to huge stress and are therefore prone to injury particularly when the HPA is negative.

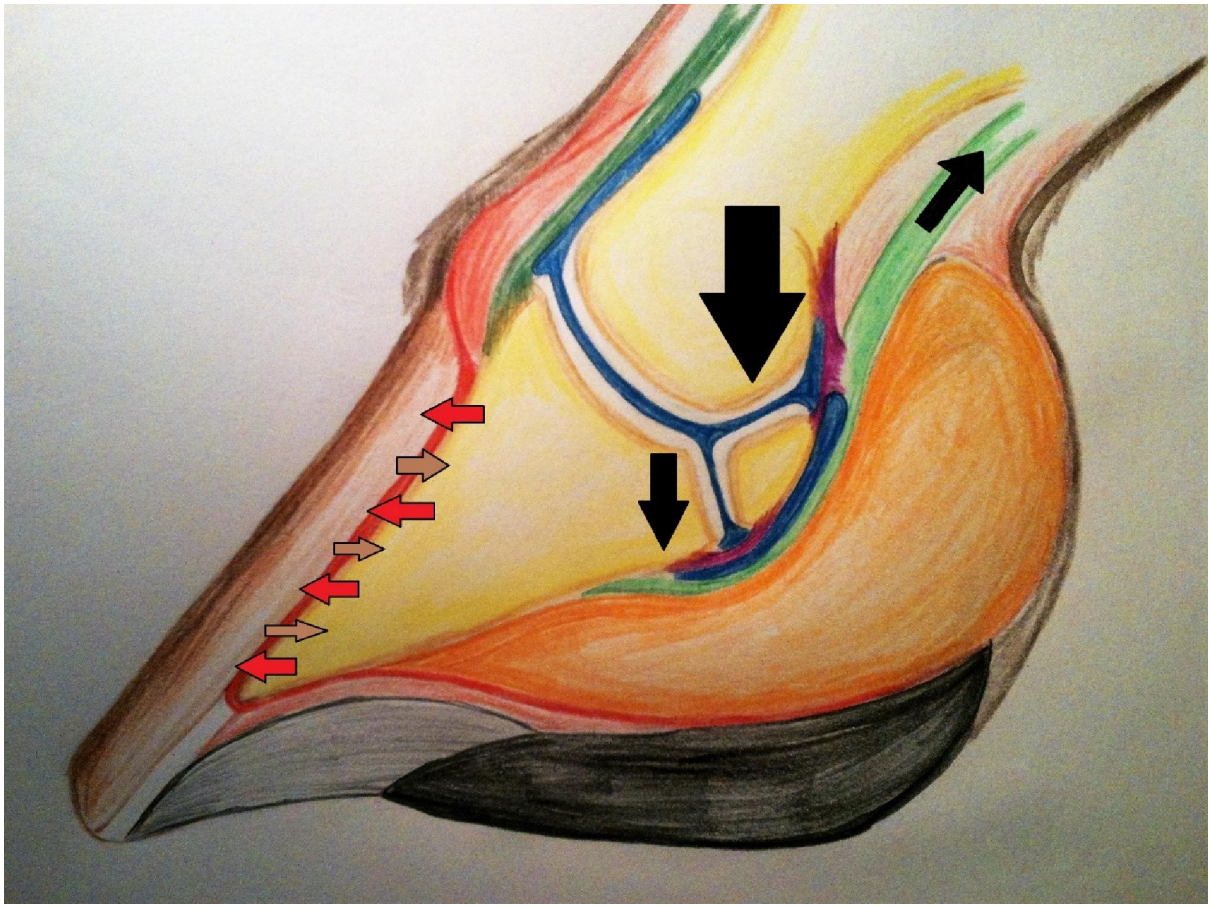

Figure 5: The descending body weight (black arrows) is supported within the hoof capsule and cushioned by the digital cushion (orange) and suspended by the attachment between the sensitive laminae and the hoof wall (red and brown arrows).

Figure 6: shoeing to correct a negative HPA without weakening the hoof wall the base (shoe) can be used to realign the HPA when the break over point of the shoe to the coronary band is used as the reference point.