Mediolateral “Balance” – Scientific insights in the context of every day hoof care and shoeing

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Definition of mediolateral „Balance“ in equine orthopeadics

Recently, “mediolateral balance” is a widely and sometimes misleading term used by equine professionals, in particular farriers and veterinarians. Aim of the presentation is to clarify terms related to “mediolateral balance” and to give an overview of current research findings with regard to trimming and shoeing.

First of all, ***“mediolateral”*** is an anatomical term of location describing the median plane as a special sagittal plane in the midline of the body, dividing an object into left and right portions (Dyce et al. 2010). The term "median plane" can also refer to the midsagittal plane of other structures, such as the limb or digit. The evaluation of an anatomical structure in its median plane is done from frontal or viewed from the back.

Prior to any treatment, ***static and dynamic evaluation*** of the horse is crucial to obtain important information and references for trimming or shoeing (Baxter 2011). Previous evaluation of horses is the duty of the farrier. Dependent on the results of evaluation, decisions are made as to which trimming method is useful to maintain or improve function of the hoof and if or which types of shoes should be optimally applied to maintain or improve soundness and performance of the horses.

Frequently, findings of static and dynamic evaluation of the horse are described with the term “balanced” or “unbalanced”. However, ***“balance”*** is a vague term used by professionals and laymen to describe the theoretical ideal conformation of the equine hoof and distal limb (O'Grady and Poupard 2001). Various groups of farriers, hoof trimmers, or veterinarians have a different understanding of the meaning of this term, related to their subjective ideals. In the author’s opinion, it has to be emphasized that the use of the term “balance” in the context of equine orthopedics should be avoided to reduce misunderstanding in the professional communication with colleagues and owners. Actually, the term “balance”, in the context of trimming and shoeing, describes various aspects – it refers to ***static-geometric, dynamic-functional***, and ***natural-individual factors*** related to the function of the equine hoof and distal limb (O'Grady and Poupard 2001).

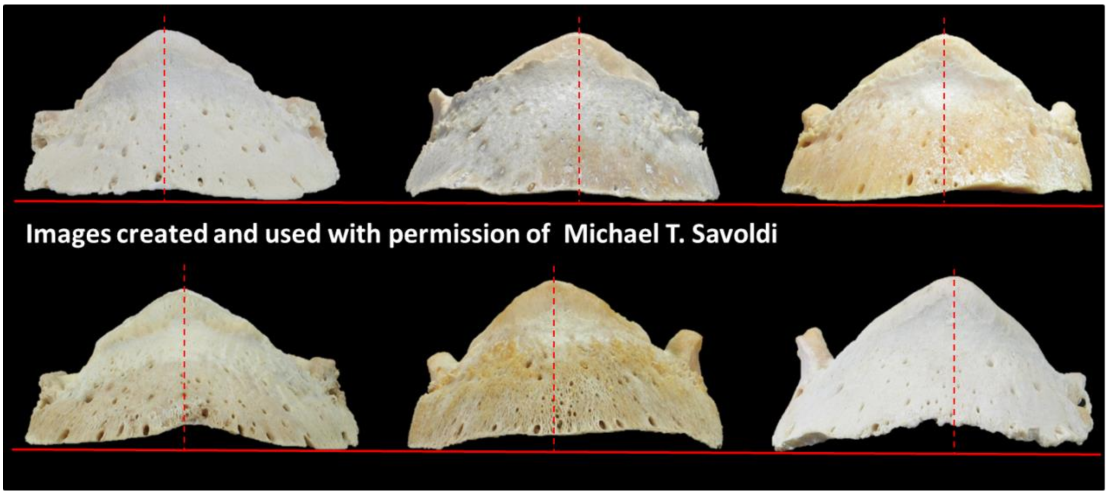
Static-geometric aspects of “balance”

Routinely, evaluation of the horse starts with the static evaluation to judge the conformation of the horse. ***“Conformation”*** is defined as the physical appearance and body shape of a horse primarily determined by bone and muscle properties (Baxter 2011). Body conformation can be inherent or acquired over a long or short-term period, or it can be currently adopted posture. Different standards and references for an ***ideal or normal conformation*** are difficult to state, because the guidelines for evaluation are strongly related to type, breed, sex, and use of the horse (Holmström et al. 1990; Sadek et al. 2006). However, some general characteristics of body and limb conformation have been established as advantageous and are related to longevity in competitive life, lower risk of injuries, and soundness (Ducro et al. 2009b). Evaluating the equine digit from the front and from behind, a vertical line is perpendicular to the coronary band and divides the toe and the hoof into two equal parts (Floyd and Mansmann 2007). The three phalanges should be in line. ***Axial deviation*** from this conformation is a base-wide or base-narrow limb posture, outwardly or inwardly rotated limbs, varus or valgus of the carpus, toe-in or toe-out foot conformation. ***Viewed from the back***, a vertical line originating from the ischial tuberositas ideally crosses the limb axis (Foor 2007). ***Deviations*** are present with an inward or outward rotation of the limb, narrow or wide at the hocks, toe-in or toe-out in the feet.

A current study examined the ***correlation between the orientation of all three phalanges and the joint space symmetry*** of the distal interphalangeal joint in 75 sound horses (Hagen et al. 2018). In general, the distal phalanx is not oriented parallel to the ground. It is slightly tilted laterally, about 1.38° ± 0.91° on the left hooves and 1.00° ± 0.95° on the right hooves. The mediolateral angle of the middle and proximal phalanx to the ground was also slightly tilted to lateral. However, individual differences occurred in the mediolateral orientation of all three phalanges. Furthermore, these examinations showed only a moderate correlation between the mediolateral orientation of the distal phalanx and the mediolateral orientation of the middle or proximal phalanx. In addition, no correlation between the distal interphalangeal joint space symmetry and the orientation of the distal phalanx occurred. Furthermore, according to the results presented in the study by Kummer et al. (2006), the shape of the horn capsule gives no indication on the mediolateral orientation of the distal phalanx and the distal interphalangeal joint space symmetry (Kummer et al. 2006). Stronger correlations have been demonstrated between the distal interphalangeal joint space symmetry and the mediolateral orientation of the proximal and middle phalanx. These findings indicate that the orientation of the middle and proximal phalanx, determining the pastern axis, is probably rather related the conformation of the proximal toe and limb than on to the shape of the hoof capsule and the orientation of the distal phalanx.

Often, axial deviations from the determined "ideal" conformation are negatively associated and are often associated with ***uneven weight bearing*** and inappropriate loading of the foot (Kroekenstoel et al. 2006; van Weeren and Crevier-Denoix 2006; Ducro et al. 2009b; Anderson et al. 2004). This was experimentally examined by creating artificially broken limb axis by using side wedges (Cauldron et al. 1998). Thereby, a lateral wedge caused medial rotation and abduction of the proximal phalanx. The opposite occurred with the application of a medial wedge. On the opposite side of the raised part of the hoof the articular space of the fetlock joint was widened. Cauldron et al. (1998) found that asymmetrical bearing significantly affects the angulation of all phalanges and articular space symmetry. Their study stated that the equine distal limb responds to asymmetrical bearing by hoof deformation, rotation of the phalanges and joint asymmetry. Side wedges (6°) also shift the center of pressure towards the raised side (Colahan et al. 1991; Hagen et al. 2016). These results emphasize the importance of uneven weight bearing in the pathogenesis of the development of joint injuries and degenerative disorders. Indeed, few types of conformations are scientifically examined to increase the ***risk of musculoskeletal injuries*** during exercising or competing (van Weeren and Crevier-Denoix 2006; Ducro et al. 2009b; Anderson et al. 2004). Nevertheless, not all conformations should be judged as abnormal or negatively. Holmström et al. (1990) examined 356 Swedish Warmblood horses and found that in the majority of horses mild to moderate limb deviations occurred (Holmström et al. 1990). In 60% of the examined horses a bench knee conformation was shown, 50% showed a toe-in conformation in the forelimbs, and 80% had outwardly rotated hind limbs. Ducro et al. (2009) stated that foot conformations (toe-in, toe-out, steep or flat feet) are heritable to a certain degree (Ducro et al. 2009a).

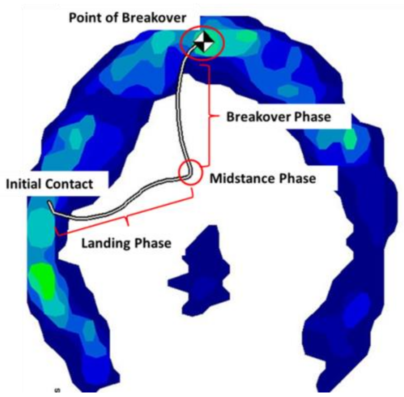
Depending on the conformation, ***hooves*** are affected by ground reaction forces and strain exerted on the hoof wall, forces acting on internal structures of the hoof, and the moment arm acting around the digital joints (Burn 2006; Thomason et al. 1992; Thomason et al. 2002). Wear pattern at the hoof capsule or the shoe indicate hoof regions with excessive abrasion. Proportions between the lateral and medial half of the hoof and the angulation of the wall give useful references about load distribution at the foot. An uneven load distribution and overloading of single hoof regions often cause alterations at the hoof capsule and enclosed structures, such as wall distortions, flares, asymmetry and compression at the coronary band, and bone remodeling (Savoldi and Rosenberg 2003; Castelijns 2006; Dyson et al. 2011). If bone remodeling already changes the shape of the distal phalanx with unilateral bone loss and asymmetric side angles, it cannot be expected that a symmetrical hoof capsule can originate from these structure.



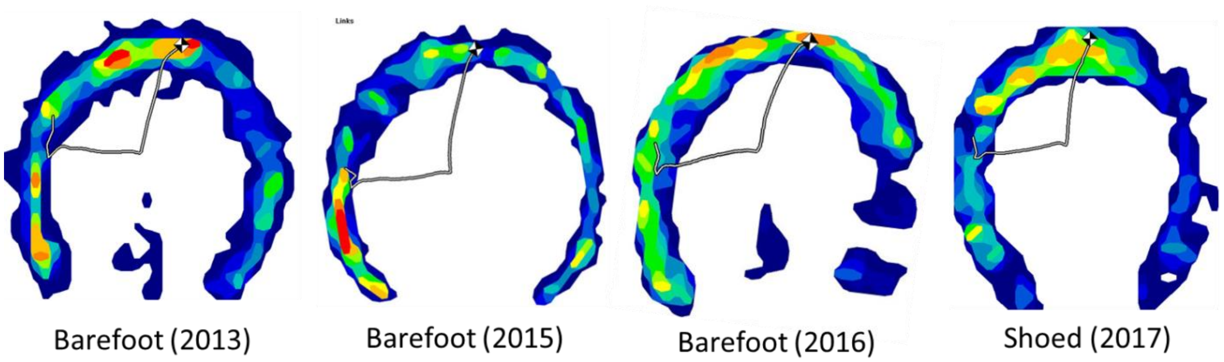
Dynamic-functional aspects of "Balance"

After finishing the static evaluation, the horse is judged ***during locomotion*** (Baxter 2011). This procedure allows observation of the movement of the limb during the swing phase and stance phase. The evaluation of the locomotion pattern in the ***swing phase*** provides information about articular flexibility, muscle activity, training, and impact of body posture (Balch et al. 1997). With regard to different references the conformation of the horse has an impact on the limb motion during the swing phase and how the limb is placed and loaded during the stance phase. However, individual combinations of different joint conformations occur and cause a wide range of different motion pattern during the swing phase.

Additional parameters are evaluated by observing the ***hoof-ground contact during the stance phase***.



During this phase the equine limb is highly loaded by ground reaction forces (GRF). These forces change their magnitude, direction, and point of application during the different stages of the stance phase. Nauwelaerts et al. (2017) evaluated the pattern of the hoof-ground contact during stance phase (Nauwelaerts et al. 2017). They showed that the center of pressure (CoP) path during stance phase is highly repeatable and unique as a "fingerprint" for each limb and horse. In own studies, it was shown that some horses show the same characteristics of hoof-ground contact over years.

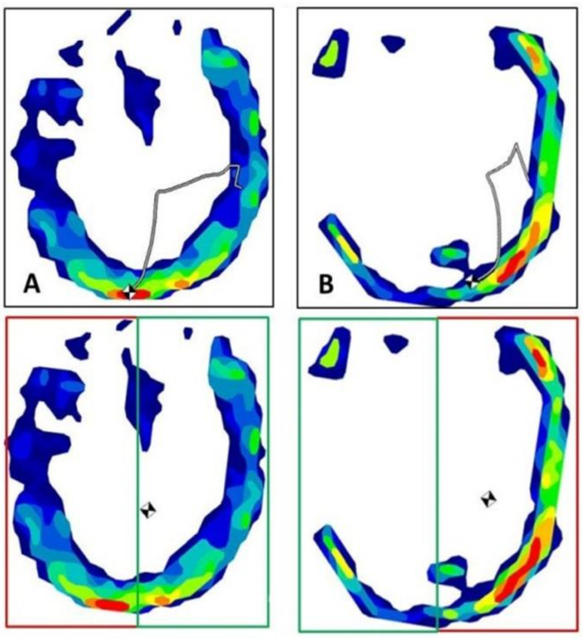


The stance phase begins with the ***landing***, which includes the initial contact. During the initial contact, impact peak forces, sudden declaration, shock, and vibration affect the foot (Barrey et al. 1991; Hagen et al. 2017c). Digital joints have to be stabilized by ligaments and tendons and forces have to be distributed across the hoof. Different landing patterns are described for horses and no agreement exists on how to judge their effect on the soundness and functionality of the equine distal limb (van Heel et al. 2004; Corbin 2004; Lange et al. 2012). With regard to different references, optimally the hoof lands flat with all parts contacting the ground simultaneously to provide even load distribution and lower effort needed to stabilize the limb (Foor 2007; Floyd and Mansmann 2007). However, various different studies describe a unilateral landing with the lateral part of the distal border as the most common landing pattern. The extent of stabilization of the lateromedial rocking motion is mainly dependent on the degree of unilateral landing. A current study examined to characteristics of hoof-ground contact during stance phase in walk in 75 sound horses (Hagen et al. 2017c). According to the results of other groups, the majority of horses showed a lateral landing (35–40%) or a flat hoof-ground contact during landing (53 -42%). In addition, van Heel et al. (2004) demonstrated that the preferred way of landing is lateral (63.3%) in the forelimbs and in the hind limbs (97.8%) in n = 18 horses (van Heel et al. 2004). Another study showed an incidence of lateral landing of 74% in walk, whereas only 5% of the horses showed a medial and 21% a flat landing in this study. In trot, the number of horses landing lateral decreased to 51%, whereas the number of horses showing a flat hoof-ground contact increased to 36% (Lange et al. 2012). This is in line with the data published by Corbin (2004), who found a lateral initial contact in 81% of the examined horses. Only in 12% of the animals was a flat hoof-ground contact observed. Very few horses showed a medial landing (2-8%). These animals showed a base-wide, toe-in conformation. This is also in line with the results of Corbin (2004), who showed that the motion of the limb in the swing phase, determined by the conformation of the limb, correlates with the landing.

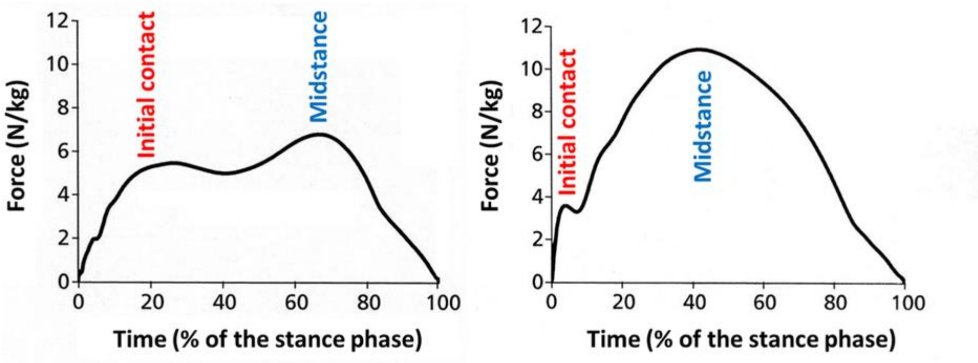
Subsequently, placement and angulation of the limb during ***midstance*** is of high importance in equine motion analysis. During midstance maximum vertical forces affect the limb (Back and Clayton 2013). Previous studies showed that during midstance the CoP was mainly located in the lateral half of the hoof in walk and trot (van Heel et al. 2004; Lange et al. 2012). In only a few horses the CoP was located close to the mediolateral or dorsopalmar center. Oosterlinck et al. (2013) showed that in walk the lateral part of the hooves was more loaded throughout the stance phase (Oosterlinck et al. 2013).

The location of the initial hoof-ground contact, the load distribution during maximum weight bearing during midstance and breakover should be positively influenced by trimming. However, there is no clear consensus what a positive effect on these parameters means. In the literature, a flat initial hoof-ground contact and an even mediolateral load distribution are stated to be optimal (Foor 2007). But as stated in the previous section, initial ground contact of the hoof is rather located laterally than flat. In addition, it is questionable if a flat landing automatically correlates with an even mediolateral force distribution during midstance. However, the current study showed only a ***weak correlation between initial contact and mediolateral location of the CoP during midstance (Hagen et al. 2017c)***.

That means that horses showing a unilateral initial hoof-ground contact do not automatically have a corresponding unilateral displacement of the CoF during midstance, and vice versa. But it also can be the case. It is very individual.



This raises the question how useful it is to trim the equine hooves to achieve a flat landing. As shown by Clayton et al. (2001), the ***force-time curves*** of the vertical GRF affecting the equine limb in walk and trot show a biphasic character (Back and Clayton 2013).



Modified based on Clayton and Schamhardt (2001)

First impact peak becomes visible during the initial hoof-ground contact, and after a short decrease of forces, highest vertical load affect the limb during midstance. These curves show the high clinical relevance of uneven weight bearing during midstance, which has been negatively associated with the kinematics of the digital joint symmetry. It is questionable if both initial ground contact and load distribution during midstance can be optimized at once by trimming according to a flat landing. Previously performed studies showed that after trimming, a flat initial contact was achievable, but not combined with an even force distribution or a reduction of the force peaks. Probably, forcing a flat landing of the hoof, load during midstance creates a medial or lateral shift, causing uneven weight bearing during the phase when maximum vertical forces affect the limb. However, this might not be the general case. As Reilly et al. (2010) showed, a flat landing of the hoof can be associated with more even load distribution (Reilly 2010). In some horses, it seems to be possible to optimize landing and load distribution during midstance, but this requires a complex evaluation of the horse. Dominik (1870) already recommended judging the complete limb conformation and the whole gait pattern of each horse before and after trimming to assess reliable references for trimming and shoeing, which is still relevant for today (Dominik 1870).

Individual-natural aspects of "Balance"

Hoof and limb conformation are strongly influenced by environmental factors (climate, ground surfaces), keeping, management, and locomotion, in particular during the juvenile development of horses (Hampson et al. 2013a; Hampson et al. 2013b; Hampson et al. 2010). Furthermore, genetics, disorders, and age change shape of the hooves, limb conformation, and locomotion pattern (Weller et al. 2006b). The characteristics of hoof ground contact are strongly determined by neuromuscular circuits (Guertin 2012; Ijspeert 2008; Forrester 2008). The characteristics of hoof-ground contact during locomotion of each horse and each limb can be defined as a result of dynamics occurring in the proximal locomotor system. The motor control of each limb and its dynamics have been shaped in such a way that the limb moves optimally. Anatomical asymmetries, lateralized training, or pain rather interfere with these biomechanically and neurologically predefined locomotor patterns than changes in hoof or limb conformation or even altered proprioception at the distal limb.
All these aspects are very individual and influence static-geometric and dynamic-functional factors.

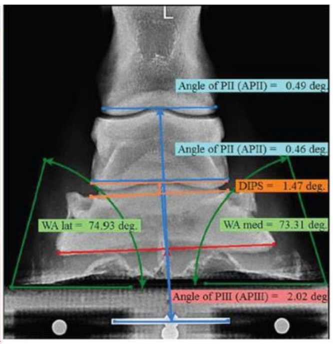
Impact of trimming on “mediolateral balance”

The impact of trimming on the shape of the hoof capsule, the phalangeal alignment, the initial contact, and the load during midstance has been examined at 70 horses divided into three groups. Horses of each group were trimmed by a certified farrier with one specific method over ten months. Short-term and long-term effects on the stated parameters were assessed by morphometric, radiographic and kinetic measurements (Hagen et al. 2017b, 2017c, 2018). However, it has to be considered that results are just valid for a specific populations and environmental conditions. It would be inappropriate to apply the finding observed in one specific population as a general ideal. A general conclusion based on the findings of other studies and the presented results is that further factors interact with the effects of hoof trimming on the examined parameters. In particular, ***hoof morphology is affected by seasonal changes in climate, nutrition, and ground conditions***. The influence of hoof trimming on the biomechanics of the equine distal limb cannot be seen isolated from the management of the horse with regard to keeping, feeding, and use (Hagen et al. 2017b). Some environmental factors might interact with the effect of trimming on the examined parameters.

Trimming methods removing a certain amount of horn have a strong short-term impact on the shape and dimension of the hoof capsule. Impact on the hoof capsule by trimming is the greatest the first few times the new trim is carried out. These short-term effects reflect the nature of the trim, but their influence is rarely sustainable and ***no significant long-term effects on the hoof morphology occurre***d. The results may be influenced by adapting the trimming intervals. Nevertheless, it remains difficult to previously estimate the long-term effect of trimming on the hoof morphology and the phalangeal alignment.

The mediolateral toe axis seems to be easier to influence than the sagittal orientation of the phalanges and digital joints (Hagen et al. 2018). ***All trimming methods resulted in a straighter orientation of the phalanges in the mediolateral plane.*** In particular, the method focused on creating a straight toe axis had an impact on this parameter. However, ***the influence occurred long-term***, whereas none of the trimming methods achieved a short-term effect on the toe axis.

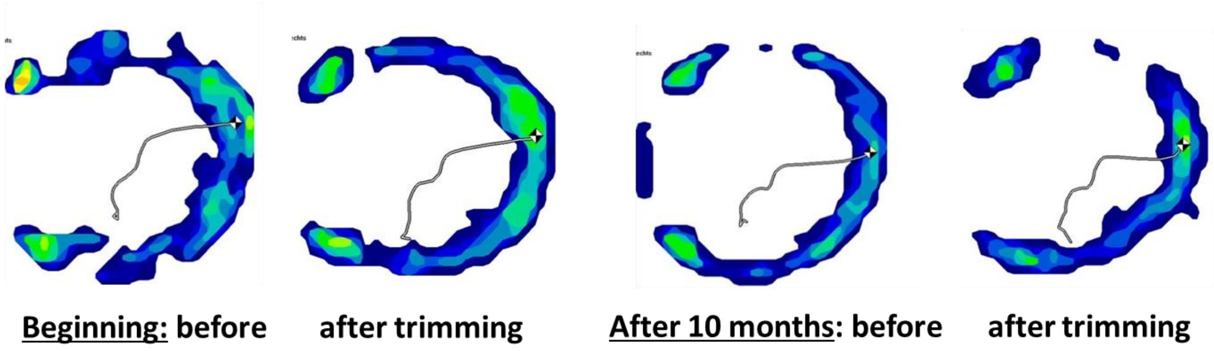
Group C	Left				Right			
APIII (°)	1.77 ± 0.76 1.68 ± 0.74	0.69	1.53 ± 0.81 1.57 ± 0.64	0.34	1.27 ± 0.76 1.23 ± 0.90	0.88	0.78 ± 0.94 0.72 ± 0.97	0.07
APII (°)	3.32 ± 1.84 3.63 ± 2.00	0.59	2.50 ± 1.53 2.63 ± 1.80	*0.05*	2.99 ± 2.97 3.18 ± 2.47	0.81	1.73 ± 1.89 1.64 ± 1.39	*0.04*
API (°)	3.72 ± 1.70 3.58 ± 1.90	0.8	2.63 ± 1.93 2.81 ± 1.83	*0.05*	4.07 ± 3.04 3.86 ± 2.47	0.82	1.91 ± 2.28 1.50 ± 2.09	*0.02*
DIPS (°)	1.07 ± 0.94 1.15 ± 1.16	0.79	0.58 ± 1.40 0.69 ± 1.03	*0.04*	1.41 ± 2.04 1.57 ± 1.40	0.75	0.13 ± 1.29 0.11 ± 0.62	*0.03*
Lon-term change of the mediolateral orientation if the middle and proximal phalanx and the joint space symmetry		Directly after trimming		10 months compared to beginning		Directly after trimming		10 months compared to beginning



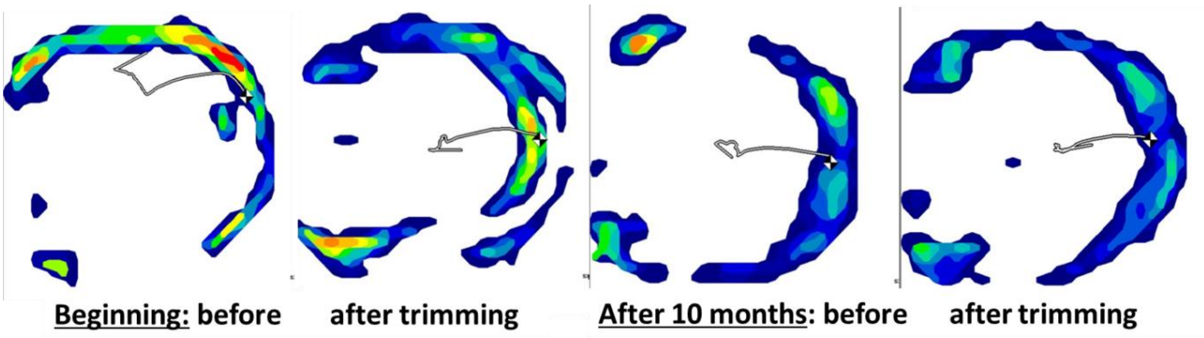
The impact of a routine trim on the hoof morphology or orientation of the distal phalanx may have less influence on the alignment of the toe than the whole limb conformation. As shown in the study by Corbin (2004), the impact of trimming on toe conformation and proximal limb conformation is limited. No changes in toe conformation (toe-in, toe-out, and regular) and the angulation in the carpal joints (varus, valgus, regular) were observed 45 days after trimming (Corbin 2004). It is more likely that the long-term adaption of posture and limb positioning in relation to trimming influences the orientation of the middle and proximal phalanx, instead of a short-term effect achieved by changing the hoof conformation by trimming. This might vary if a corrective trim is performed by a distinct unilateral shortening of the hoof. Documentation of own work might be useful to achieve more specific results. With regard to the static geometric references used for trimming, it can be concluded that trimming according to axes, numbers, proportions, and angles considers the ideal, but might reach its limits in the practice. A strong variation in hoof and limb conformation exists, interacting with the impact of trimming on the hoof morphology and phalangeal alignment. Instead, focusing on the hoof morphology and toe-pastern-axis, the evaluation of the whole body conformation with regard to the shoulder, chest, back, and pelvis, in addition to functional parameters such as load and gait pattern, seems to be a more useful reference to estimate the possibilities and limitations of trimming. In the end, a few millimeters of hoof horn is shortened and counteract with the load determined by the whole body weight and the general body conformation. ***Aesthetic ideals should not be put above functional demands of the horse.***

With regard to the dynamic evaluation of horses for trimming, the findings of the study clearly show the ***individual variation in the initial hoof-ground contact (Hagen et al. 2017c)***. A flat landing might match the ideal and might be associated with even load distribution during the initial stance phase, however various studies confirmed that ***lateral landing*** or even toe landing can be ***judged as physiological gait pattern***. In particular, the weak correlation between the initial contact and the location of the CoF during midstance makes it questionable to force a flat landing by trimming. A flat landing during initial contact can be associated with more even weight distribution during midstance, but it does not have to be the case in each horse. Results show that changing the initial contact might provoke a unilateral shift of load during midstance, which might be harmful for joints and soft tissue. In addition, dynamic parameters are difficult to assess by solely watching the horse. The human eye is, at 24 Hz, too slow to accurately assess the character of fast periods of the stance phase, such as landing and breakover (Weller et al. 2006a). Therefore, the evaluation of gait pattern and trimming to achieve a flat landing remains to a certain degree subjective. Reliable information relating to this point can only be assessed by using technical devises for motion analysis as described previously.
The ***different hoof trimming methods had specific short-term and long-term effects on the geometry of hoof-ground contact during walk (Hagen et al. 2017c)***. Directly after the first trim, the number of horses showing a flat initial contact increased by about 12.5% in the group trimmed to improve the mediolateral orientation of the hooves (group A). Evaluation of the short-term effect on the initial contact in horses trimmed by using a method considering individual-natural factors (group B), showed an increased number of horses with a lateral landing. In the group trimmed according to the pastern-axis theory (group C) the number of animals showing a toe-first landing increased by about 31.8% (left feet) and 22.7% (right feet). No significant short-term effects were observable for the mediolateral location of the CoF and the point of breakover in any of the groups. The observed effect on the initial contact in the horses trimmed to improve mediolateral orientation of the hooves was sustainable during the eight-week trimming interval and during the whole examination period of ten months; the number of horses showing a flat landing even increased about 23.8% (left feet) and 36.6% (right feet) until the end of the study. With regard to the ***mediolateral location of the CoF, no significant long-term displacement was evident in any group***. The effect of trimming on the hoof-ground contact during the stance phase has already been a topic of previous studies. Corbin (2004) showed in her study that the preferred lateral landing in horses did not change directly after trimming or after 45 days, although these horses were trimmed with the aim to create a flat landing. In some horses a tendency towards a flat landing occurred, however by applying horseshoes this effect was eliminated. Peham et al. (2000) also examined the effect of this trimming method on the initial contact. Horses were trimmed to specifically achieve a flat landing (Peham et al. 2000). However, it was shown that this effect is not sustainable during the eight-week trimming interval. Horses directly returned to their individual landing pattern. In addition, this study found a strong relationship between limb conformation and the preferred landing pattern, which was confirmed later on. It is questionable as to what has the stronger influence on the gait pattern: the conformation of the horse and neuromuscular determination of the motion pattern, or the minimal horn removed by trimming.

In this context, the current study showed that ***in horses with short-term acquired deformities of the toe caused by hoof growth, strongest and most sustainable effects on the initial contact could be achieved***.

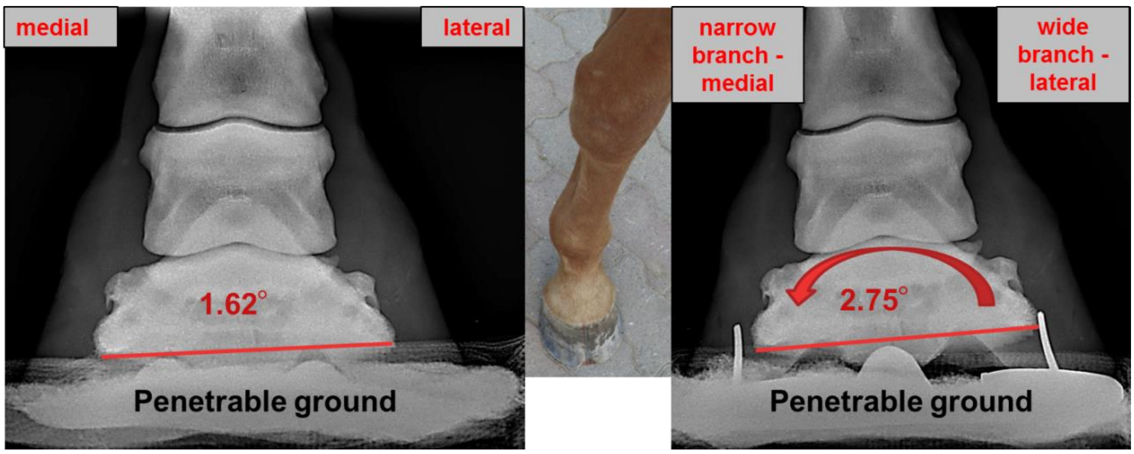


In horses with inherent or long-term acquired limb deformities and more proximally located angular limb deviations, the influence of trimming on the gait pattern was very limited.



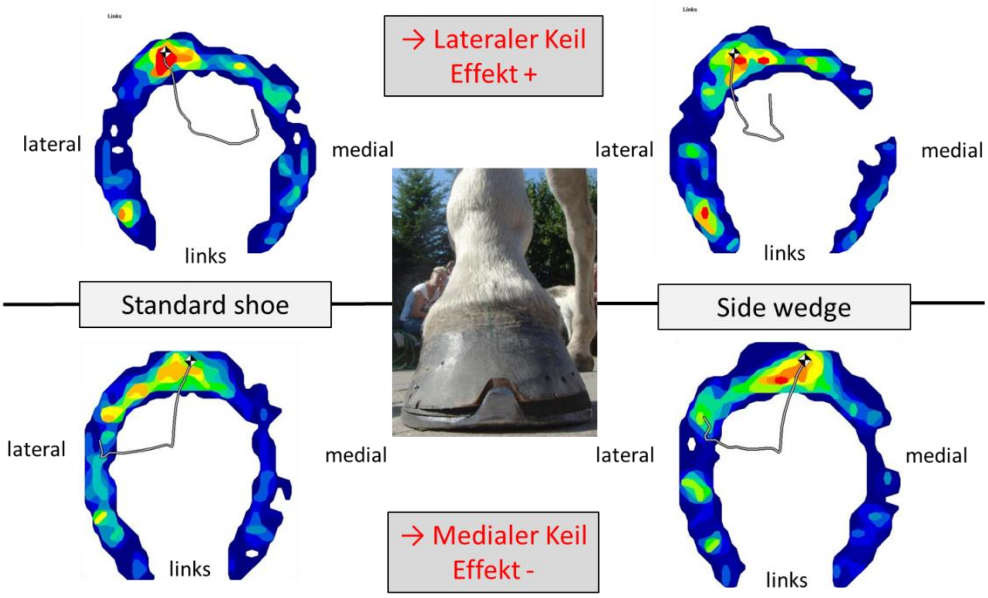
Impact of shoeing on "mediolateral balance"

The impact of shoeing on the phalangeal alignment and the characteristics of the hoof-ground contact during stance phase in walk has been examined using 25 sound horses (Hagen et al. 2017a; Hagen et al. 2016; Hüppler et al. 2016). The results of the study show that the application of modified horseshoes altered the angulation of the hoof and the distal phalanx. However, this effect was related to the design of the shoe and the surface conditions the horse is standing on. The use of a Wide branch shoe on penetrable surface caused a change in hoof angulation due to reduced sinking of the wider branch into the ground (Hagen et al. 2016).



The mediolateral angulation of the distal phalanx changed about 0.5° - 1°. The effect on the joint space symmetry of the distal interphalangeal joint showed severe individual variations and was not

calculable. Homogenous effects occurred by using a side wedge of 4° to elevate one side of the hooves. A change in hoof orientation and mediolateral angulation of the distal phalanx became obvious on firm ground with a narrowing of the joint space at the elevated side.
However, it is questionable how a change in hoof angulation, caused by shoeing, influences the angulation of the proximal and middle phalanx or the distal interphalangeal joint space symmetry. With regard to this question, no significant changes were found (Hagen et al. 2016). The mediolateral orientation of the middle and proximal phalanx or the joint space symmetry was not significantly affected by shoeing. Instead, severe individual variations in the response of these parameters on the different shoes occurred.
In addition, the study showed that modified horseshoes change the pressure distribution affecting the solear surface of the equine hoof. Due to reduced sinking of the wide branch into penetrable ground, pressure peaks occur underneath the wide branch. Using a side wedge shifted the load to the elevated side (Hagen et al. 2016).
Shoes equipped with heel wedges or studs, and rocker shoes, in particular, changed the landing of the hooves. All shoes caused an increased mediolateral or dorsopalmar instability in the phase from initial contact to midstance on firm ground (Hagen et al. 2017a). Increased instability during landing has been associated with high load of the digital joints. This effect was increased in horses showing a unilateral landing. Landing first on the medial or lateral wall has been clinically assumed to cause unilateral overload at the side the hoof is initially contacting the ground. Therefore, one approach is to shoe horses showing a medial or lateral landing with side wedges on the opposite side of the hoof. In the current study the effect of a unilateral side wedge on the geometry of hoof-ground contact was examined in comparison to the use of a standard horseshoe. Based on these measurements, it was shown that in one horse the medial landing was changed towards a plane initial contact by applying a lateral side wedge. Two more horses showed slight changes of the initial contact, and two horses were able to compensate the effect of the side wedge on the landing (Hagen et al. 2016).



As stated by Lange and Corbin (2004), the conformation of the proximal locomotor system (shoulder, chest, back, and pelvis) strongly determines the motion of the limb during the swing phase, which in turn affects the landing during the early stance phase. However, it has to be emphasized that in all horses the load of the elevated side significantly increased, meaning uneven load during midstance, when highest vertical forces affect the limb. Uneven weight bearing has been correlated with uneven load affecting the joints, which is predisposing for unilateral arthropathies and lesions in the collateral ligaments (Dyson et al. 2004). Therefore, care must be taken to carefully evaluate the horse when using side wedges for corrective purpose with regard to landing or limb deformities. Another effect on the initial contact was partly assessed for the shoeing with a wide branch shoe. In two out of five horses a slight shift of the initial contact to the broadened branch was seen. This might be related to increased weight caused by the wider branch (Hagen et al. 2016). This effect can be interpreted as an unintended side effect; however, in other applications the influence of unilateral weights on the motion of the limb in swing phase and subsequently on the initial contact is used.

The complexity behind the term "mediolateral balance" became obvious. To achieve optimal results by trimming and shoeing professionals should focus on the described aspects instead hiding behind vague vocabulary. It is essential that farriers and veterinarians are educated in anatomy and biomechanics to apply it correctly in their daily work to maintain even load of the hooves and limbs during stance and locomotion related to the individual properties of each horse.

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