# Inter- relationships between orthodontics and posture: basic theories

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**Summary**

**The first part of the present report deals mainly with the concept of posture – both in static and in dynamic sense – its relationships with equilibrium, weight balance and motion, its phylogenic origin, reasons why any orthodontic professional should be aware of it; moreover, different profile types and their connections with one's own skeletal class are briefly discussed. Two more papers are following on the subject.**

**Key words: posture, gravitational vertical line, skeletal class, balance.**

## How may posture be defined?

There's plenty of different definitions of the term 'posture', some foggy and useless like the ideas of their creators, some merely tautological, many contradicting each other, and some really hard to understand.
Ricciardi (1) employs a definition for the wide audience: "the posture is nothing but the result of a complex interaction among brain, sense organs, and emotional states; the positions we adopt on our own are a kind of topographic map of the human being; it's our way of getting in touch with reality, the physical and mental expression of neurovegetative system, of the actual state of mind".
Messa (2), too, addresses the large public by stating that "the posture is also the expression of the physical state; it would be better speaking of a postural system".
Here joins the club Henry Otis Kendall (3), who adds another capital brick to our wall as saying that "posture can only be viewed like the situation characterized by the whole of the positions of body articulations in any given moment":
Annibaldi (4) makes the following point: "posture, as a complex expression of the state of nervous system, is substantially the way in which each subject reacts and rules its body, still or in motion".
Calandriello et al. (5) provide the following definition: "standing posture of every person may be represented by the spatial inter-relationship that head, trunk, arms and legs assume with regard to each other".
In the Internet site held by Rinaldi and Fontani (6) we can read this simple statement: "posture is best defined as the position maintained by our body both still and in motion".
A professional with consistent knowledge in the field of body posture might find almost plain the sentence "Most credited protocols of postural evaluation are essentially based on models of structural and bio-mechanic analysis of both skeletal and myo-fascial ties among different bone segments and districts (7)".
In the very same paper by Urzì can we read a definition we find very useful for our goals, that is to say "posture is every position our body is able to assume and maintain (therefore in equilibrium or weight balance) in any given circumstance".
The author goes on by stating that "the preferential synergies of muscular chains are more important for stabilizing than for dynamic purposes".
Even though we can easily identify many a functional manifestation able to get – and to keep – body equilibrium (e.g. the rhythmic oscillations which do constitute a basic control function), one should take note that a concept of stable body posture is normally individuated in orthostatic position, that is to say standing attitude and free two-footed weight charge.
Normally this position is maintained through activity of muscles counterbalancing gravity, the so-called tonic extension muscles.
A problem arises, when we realize that this position is completely different from that in which we usually see our patients…
In case this sentence holds true, it wouldn't be a bad idea at all if we changed our mind and, from this moment on, we started examining our first visit patients both traditionally seated and standing, in such a way as to be able to form a more comprehensive frame.

## Phylogeny and posture

It would seem of undeniable interest detecting how posture finds a place of its own along phylogenetic evolution, and the way orthostatic position will be situated at the very top of such an evolutionary asset.
In order to demonstrate this assumption, may we consider the series of passages from the fish to the amphibian, to the quadruped, to ape and to the two-footed hominid.
In spite of the fact that fish already owns a kind of laby-

rinth, the latter only is active to give information on body spatial position, since body lay out in water is practically neutral because of the existence of swim bladder, situated top of body barycentre, which makes more input for reflex antigravity activity meaningless.
Moreover, here no lateral mobility of head with respect to trunk may be detected.
The amphibian is bound to counteract gravity force, which acts more on them than on fish, owing to the new out-of-water situation, nevertheless should we consider the broad support basis (limbs in side position) and the extremely low height of body centre to ground (amphibians creep with belly on the ground, thus dissipating a considerable energetic amount because of attrition); as a result, no balance problem can be observed.
Head rests on collarbones in order to sustain its weight but, as already seen in the fish, it practically has no lateral mobility as to trunk.
The quadruped – to use a beautiful sentence by Sartori (8) –issues its challenge to gravity, which is accomplished by barycentre elevation from floor in the same time that head finds its freedom from trunk (which stays parallel to floor) by placing itself in antero-superior position.
And if the evolutionary step from creeping towards the upright-on-paws-condition finds its justification on the basis of mechanical advantage (little or no attrition at all), more bio-energetic motivation is supplied by the effort paws must endure in thrust phase: upright below body, as a matter of fact, the effort is largely reduced as to side position.
This step also makes the presence of anti-gravity reflexes necessary (reflex of uprighting, of equilibrium, parachute) as stability progressively grows into a major issue.
What about the biped? As trunk gets vertical backing up only on lower limbs, we may see full expression of potentiality in elevation, thus completing adaptive evolution in a context where weight force is king.
There's plenty of advantages offered by this new situation, and all of them remarkable.
First of all, hands get free and may be fully exploited; then, a better view of the nearby environment with horizon enlargement; moreover, much better breathing conditions are offered (breathing is more economical in the higher position, since savannah is usually sultry); last but not least, sense axes are offered a much improved locomotor stability as to living on trees apes.
Head control is therefore fundamental to keep stable sense axis useful to orientation (placed exactly in the head, hence the necessity to keep bi-pupilar axis parallel to ground, no matter how hard; head freedom only is allowed by neck tonic reflexes (both symmetrical and asymmetrical).
At the end, top of homination process (that is to say hominid / pongid splitting) is characterized – together with fundamental postural uprighting matched with the two-footed locomotion – by a spectacular skull expansion (articulated language plus ideational processes that, coupled with hand freedom, offer way to unbelievable openings, from development of material culture to Internet) and by remarkable reduction of jaws protrusion combined with net arrangement of tooth arch, from tooth series reduction and gradual molar overpower (9).
In order to explain this series of changes, the hypothesis has been advanced that dental arch may have not been any longer necessary to perform tasks once fulfilled but now in charge of the "prehensile hand" (opposable thumb + erected station).
Thus, a lowering of the canine cusp may be observed, with occlusion change and primate diastema disappearing (at least at statistical significance level), analogous reduction and lowering of molar cusps (even though at a milder degree when compared to front section) with – as a result – a progressive functional prevalence exhibited by the back sections.
This whole series of phenomena didn't obviously appear at the same time: scientists tend to exclude any rigorous synchronism of the steps and, even though a very tight functional relationship may be individuated, at this moment our anthropologic acquaintances suggest the following reconstruction: skull expansion (with all its connections) seems relatively late, whilst postural uprighting is for sure earlier, though not precisely identifiable on time scale: might have taken place some fifteen million year ago, anyway not less than three million year ago, consequently then already present in individuals whose brain (and related intellectual powers) was still very little.

## Why posture should be of interest to any (good) orthodontist

Even taking for granted every single step as seen, one may wonder why an orthodontic professional should be interested in posture whatsoever.
There's many a reason why: may we start by saying that in our field – nowadays especially – it only would seem crazy not taking aesthetic factors into account.
As a matter of fact, an orthodontic treatment outcome is often (right or wrong) judged only, or at least prevailingly, according to the degree of facial aesthetic harmony the orthodontist was able to reach. Moreover, even choosing to only speak function, who among us would on purpose close any orthodontic case he treated with a canted occlusal plane?
Accordingly, we can't avoid observing (and taking into account) the way our patients keep their head in relaxed spontaneousness, whether straight, inclined or whatever; in particular, one should examine the situation as observed "three quarters" view, that is to say the most frequent angle (Fig. 1) we are usually watched from others on social occasions (and consequently judged or evaluated on a 'interesting / not interesting' scale).
A fortiori we are therefore stimulated to investigate whether our patients' cervical column shows a correct curvature or not (by the way, this is a capital though often neglected point, as said before: usually sitting posture – the one usually our patients are seen by us – is <u>not</u> the same as standing: we had better keeping this into account and taking the necessary steps) both statically and in motion.
Let's start this very short excursus from a survey on body posture as observed in its relationship to vertical axis.

## Sagittal aspect (Barré's vertical axis as observed in latero-lateral direction)

Usually in most orthodontic offices there isn't a postural analyser available (with revolving footboard and upper mirror, not to speak of an adjustable twin-mirror).
No problem: we only need a plumb line, that might be free (in which case we use it free-hand) or hanging from a tall

Figure 1 - "Three quarters" view, most frequent 'social angle' one is usually watched.

enough support.
If this little tool is not within reach, we can even do with a vertical wall free from other things, having our patient position her/himself in a 'spontaneous standing' condition, that is to say feet on the same level but without obliging to a predetermined distance or angle between them just in front of the vertical line indicator (we don't favour using pre-glued to the floor templates that tend to limit the physiologic positional gamma too much): let's consequently observe which features of tonic muscular activity are shown by our patient orthostatically upright with respect to the vertical gravity line on the sagittal plane (that is to say watching her/his profile).
Particularly, we are bound to examine distances from the vertical line of three benchmark points: most salient point of gluteal prominence, most posterior point of physiologic kyphosis of the dorsal column and most posterior nape point (exterior occipital prominence).
Ideally, these three points should lie on the same line parallel to vertical Barré's line.
In the same manner we should go on evaluating distances (always from the gravity vertical line) of most anterior point of neck's posterior part (cervical arrow) and of most anterior point of lumbar column lordosis (lumbar arrow).
As already anticipated according to posturologic criteria, in well-balanced subjects these three distances (gluteal, dorsal and occipital) should be almost equivalent.
Beside this good alignment, should we observe some other features: a very, very small (not more than minimal) activity of anti-gravity muscles (tonic extensors muscles) whose activity is requested in order to stabilize lower limbs, pelvis and column (and exactly a pelvis in optimal balance, neither forward nor backward inclined) with barycentre falling almost in the centre of the body projection polygon (even if a bit forward as to coxofemoral articulations).

**Forward and backward inclined profile**

Anyway the just outlined frame, such a 'situation of ideal norm', as someone (8) liked to define it, is by no means the one and only we could come across.
As a matter of fact, it's by and large more frequent the statistical observation – among the many other possible body postures – of the three situations we are to watch in some detail.
- *1st frame:* the three benchmark points (gluteal / dorsal / occipital) lie on the same axis, but we face accentuated curves; usually we see this frame in patients with a valgus foot feature;
- *2nd frame:* gluteal distance is considerably decreased as compared with dorsal and occipital ones, with less deep vertebral curves; this frame, featuring forward placed body barycentre (owing to column and head in forward position in comparison with gluteal prominence) is usually identifiable in association with hollow foot; this is usually referred to by posture professionals as 'forward attitude' tout court;
'Backward attitude' will on the contrary be therefore the 3rd frame whose main features are occipital and dorsal arrows clearly decreased as compared with the gluteal one, obvious and consequent shifting towards the back of the body barycentre; we may also note accentuated vertebral curves and frequently a flat foot.

**Mutual relation between profile and orthodontic skeletal class**

Any professional dealing with body posture likes to refer to himself (10/11) as a physician 'horizontally' working, since his specialty holds many a contact with other health workers (ophthalmologists, dentists, neurologists, ENT specialists, orthodontists, orthopaedists, gastroenterologists, rheumatologists, cardiologists, orthoepists, paediatricians, kinesipaths, orthoptists, psychiatrists and so on).
According to their opinion on our field, a strong biunique bond does exist between orthodontic skeletal class and postural profile (whether forward / normal / backward), bond that can easily and usually be observed.
Thus, subjects exhibiting an orthodontic skeletal class I tend towards a neutral and steady profile position, the ones presenting an orthodontic skeletal class II usually show anterior profile position – normally almost as stable as class I); orthodontic skeletal class III subjects, on the contrary, will tend to be both backward positioned and unsteady (of course always from the standpoint of postural balance); forward inclined position usually tends to match with the so called 'griffe' of toes (Figs. 2 and 3), that is to say an attitude, as of claws, designed to guarantee exactly some stability even in the presence of such a positional frame.
As an obvious implication of this observation, it follows that we clearly don't need making a skeletal class diagnosis by watching more forward or more backward position of both head and column as to gluteal plane (much more reliable orthodontic investigation tools are available), but we could easily (and usefully) take advantage of such a statistically sensitive observation in order to suspect, for instance, a potential *in fieri* class III in a boy (who maybe doe-

Figure 2 - Griffe' of toes, lateral view.

Figure 3 - Griffe' of toes, superior view.

sn't offer any other alarm bell, let's say who exhibits a full dental and skeletal class I, chewing and facial musculature in the norm, harmonious face profile, nasal breathing, non-progenic parents and relatives) and put him under regular control visits.
It may clearly be a false alarm, but it wouldn't cost us nothing.
But what if said boy would show out of the blue sky another slight, little brick of class III syndrome? That would obviously call for attention, and we could perhaps detect in advance an incipient mandibular growth spurt that, in the absence of the postural beep, we might as well have neglected, at least in the initial onset.
In our opinion, it's surely worth losing a little time after it.

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