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Taking stock: passing the torch, who has the light? Reflections about teaching orthodontics at the occasion of the retirement of Prof. Lysle E. Johnston, Jr PhD

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Taking stock: passing the torch, who has the light? Reflections about teaching orthodontics at the occasion of the retirement of Prof. Lysle E. Johnston, Jr PhD

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In the Marburg (Germany) 5-year dental curriculum, students enter the orthodontic department in the middle of their third year. Our teaching is student-centered and problem-solving oriented. From day 1 our students are trained to diagnose in three separate levels of development i.e. (i) craniofacial growth, (ii) development of the dentition and (iii) maturation of function. These three levels are kept separate throughout patient examination and up to the strategic treatment planning phase. The examination is performed with the help of three checklists, one for the facial morphology, one for the dentition and one for function. The three resulting problem lists then undergo reduction by selecting one 'key problem' for each level. Next, for every key problem three 'standard solutions' are offered, not in the form of appliances but as vectors that can modify growth. Finally, in a strategic planning phase, one treatment option from each of the three levels is selected and combined in a single, be it hypothetical, treatment plan. Parallel to these, students are exposed to treatment mechanics through the presentation of selected orthodontically treated patients. In our experience the advantage of this diagnostic procedure lies in the structured organization that serves as a GPS system for student and teacher and enables them a clear communication about where they are and what has to be done. By design, treatment options have taken priority over treatment mechanics. We are confident that our students, equipped with real life diagnostic skills, are well prepared for their orthodontic future.

Introduction

To develop an undergraduate orthodontic curriculum is a real challenge; a fact well known to educators in orthodontic departments worldwide. For the graduate programme there exists a sort of consensus, based on the Chicago–Seattle heritage, but for undergraduate education no blue print exists. Yet, every dental license allows the holder to provide comprehensive orthodontic treatment.

Orthodontic problems are fundamentally different from caries. They usually result from slight deviations from otherwise normal dentofacial development; and the therapeutic approach is to reverse or intercept these deteriorating influences on growth. From this it follows that a timely diagnosis is of paramount importance. It is the intention of this paper to explore what diagnostics we should teach our dental students, in order to prepare them adequately for their professional future.

Orthodontic diagnostics is more successful when compound problems are broken down into smaller units, each of which can be handled by a formal treatment plan. To that goal rules for a so called 'problem solving cycle' have been applied to facilitate the breakdown of a problem list into 'key problems' with the subsequent selection of 'standard solutions' for each key problem. Only at the end, during the strategic planning phase, the selection for appliances is made. In Table 1 the four steps of this procedure are depicted as a flowchart.

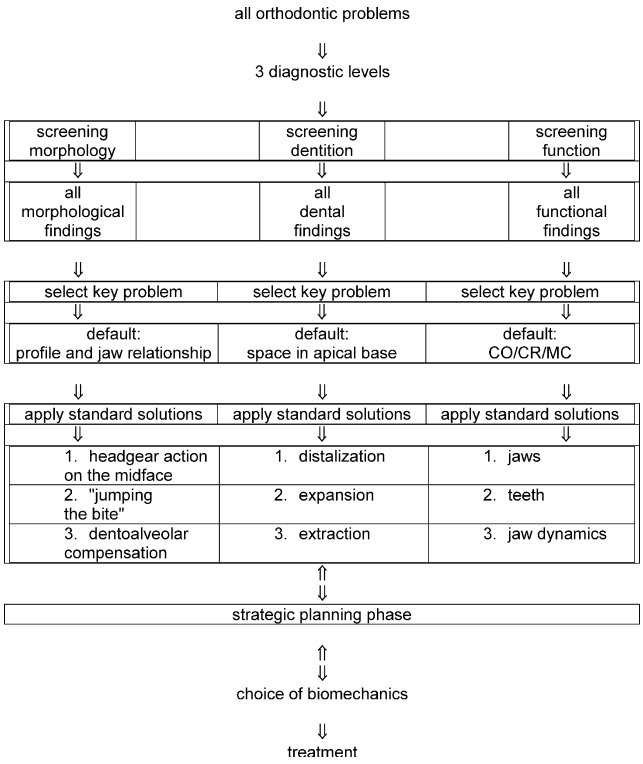
In the first step, examination of patient, it is of paramount importance to discriminate between the three different developmental levels of craniofacial growth i.e. to strictly separate morphological, dental and functional findings. This will result in three different problem lists, one for morphological, one for dental and one for functional problems.

The second step serves to shorten each problem list by ranking the items, placing the most important one on top. In this way a principal or 'key problem' is selected for each of the three diagnostic levels separately. In conclusion a 'key problem' for each of the three levels, the morphological, dental and functional level should be selected at the end of second step.

The third step concerns the solution for the problem. For each key problem there appears to be available only a limited number of standard solutions that can guide the development in the desired direction. As an example, a skeletal class II can be orthodontically treated with an activator, a bionator, a Fränkel, a Herbst etc. all of which belong to the standard solution 'Jumping the Bite'. Careful analysis revealed that each key problem only has a limited number of standard solutions. Each of these morphological, dental and functional standard solutions has their advantages and disadvantages, which have to be considered. Defining the standard solutions for each of the three selected key problems then, facilitates problem solving.

The fourth and final step comprises the strategic planning and starts with an inventory of the selected standard solutions and combining these into one strategic treatment plan. A crosscheck against the leftovers from the problem list in the second step is made to assure their incorporation in the final treatment plan.

Table 1. **Flowchart of the orthodontic decision tree based on a problem-solving cycle approach to orthodontic problems**

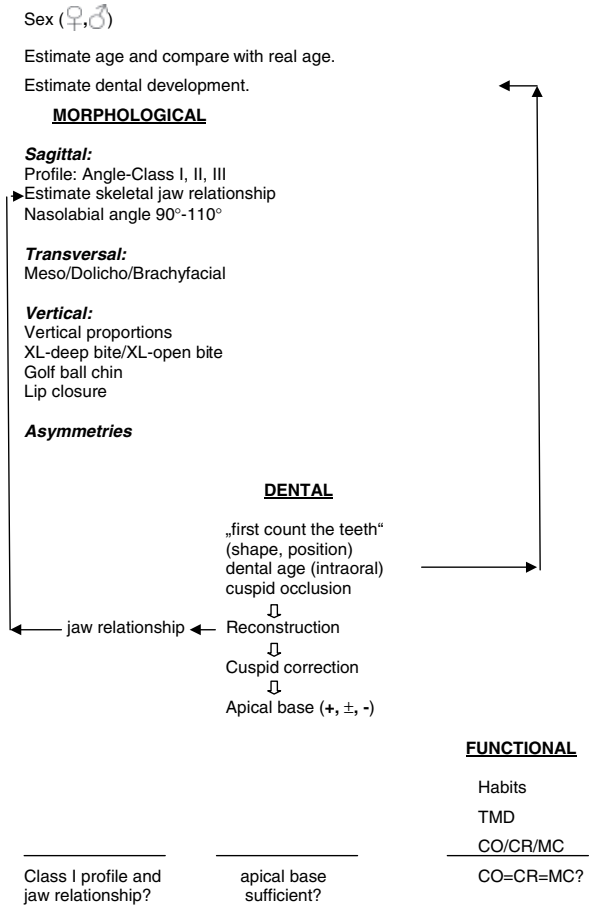


The procedures in detail

The screening procedure and checklists are depicted in Table 2.

Facial aesthetics, dental development and jaw function constitute the three basic levels that have to be

Table 2. **Patient examination checklist**



explored for a full diagnosis. In order to avoid omissions and errors, checklists in the screening phase for each of these diagnostic levels are very helpful to the student. Thus, there is a morphological checklist for screening facial aesthetics and craniofacial growth, a dental checklist for examining dental development, and a functional checklist to check function.

The morphological checklist contains items about facial form and structure that are the result of bone, cartilage and soft tissue growth.

Morphological checklist

Sagittal	Angle classification for the profile
	Expected jaw relationship
Transversal	Dolicho- meso- or brachyfacial
Vertical	Upper face, midface and lower face proportion
Symmetries	Gross asymmetries

The dental checklist contains items that concern dental development, brought about by enamel and dentine formation, development of the periodontal ligament, and, notably, from the capability of teeth to drift.

Dental checklist

1 First count the teeth: number, shape, position, rotation.
2 Dental age.
3 Occlusion (Reconstruction of skeletal jaw relationship. Check with profile).
4 Space available in the apical base.

The functional checklist contains items that concern the 'dynamic communication' between the dental arches of the mandible and the maxilla.

Functional checklist

1 Parafunctions; habits.
2 TMD.
3 Centric occlusion, centric relation and muscle centric.

Once the three checklists have brought to light individual developmental problems, the next step will be weighting these findings. Not all deviation from midstream dentofacial development will have equal deleterious impact and it becomes essential to make a list of weighted problems, designated the 'key problems'.

Key problems – in search for the morphological key problem

At the morphological level the analysis is divided in sagittal, transversal, vertical and symmetry items. Sagittally, the facial profile can be changed by orthodontic therapy. Transversally, orthopaedic procedures are not capable to increase or decrease face width. Vertically, large deep bites or open bites tend to cause difficulties during treatment. Finally, in exceptional cases where normal variation is exceeded, symmetry has to be corrected by a team of experienced specialists. Asymmetry may be obvious even for lay people, treatment, however, is well outside the scope of routine orthodontic procedures.

As the sagittal dimension by far is our most frequent treatment objective, the profile, together with its

underlying skeletal jaw relationship constitutes the default morphological key problem that has to be considered first in treatment planning.

Search for the dental key problem

Irregularity of the teeth is the most obvious one of all orthodontic problems. Rotated teeth and teeth not well aligned in the dental arch are visible to the public. The correction of these malpositioned teeth with fixed appliances is not a serious problem, on the condition that there is enough space available. Creating space by bringing the crowns in a larger circumference – expansion – does not really solve the problem. Teeth have roots that must be aligned with proper angulation and inclination. The apices of the roots occupy a horseshoe shaped space called the apical base. Imagine a dental arch, be it wide or small, with no space deficiency and with an alignment of the teeth in accord with Andrews' six keys to occlusion. Such an arch, by definition, will be rooted in a sufficient apical base. Conversely, deficient space conditions in the apical base set a limit to the space available for the dental crowns. Crowding of teeth, in the front or in the buccal segments, is the visible result of a space problem at the apical base level. Apical base space problems therefore should be solved before, and not through, alignment. At the dental level the default key problem is availability of space in the apical base region, a problem that surpasses irregularities or rotations of teeth by far in importance.

Search for the functional key problem

Parafunctions and habits only form an orthodontic problem when not diagnosed timely and therefore they belong to the domain of dental prevention. As there is no proven causal relationship between TMD and orthodontic treatment, TMD is not a key problem. Functionally one expects a smooth movement from a rest position of the mandible, the muscular centric (MC), into a central occlusion (CO), being not in conflict with the central relation (CR, defined in the most liberal sense). The default functional key problem is defined by a deviation from a smooth movement from the mandibular rest position (MC) into a centric occlusion (CO) and a (central?) relation (CR) of the lower and upper jaw and not in conflict with the integrity of musculature.

Standard solutions

There exist a variety of options to treat an orthodontic problem and each solution can operate through a variety of appliances. Appliance and solution are two sides of the same coin. Unfortunately, for the orthodontic novice without experience in mechanotherapy, a most important part of the decision tree remains obscure. This is the vicious circle that faces everyone who had to develop an orthodontic curriculum (without experience no solution and vice versa). Systematic analysis to the nature of the key problems revealed that biomechanics used by experts reduced the possible solutions to only a few. These essential biomechanical solutions, not appliances, we called 'standard solutions'. For each of the default key problems there appear to be three standard solutions.

Morphological standard solutions

We have to limit our text to class II, but for class III simply the reverse holds true, the only difference being the chances at real success.

The default morphological key problem is a class II profile with a class II jaw relationship. For any class II there are three orthodontic solutions. Either:

1 Application of headgear force to the maxilla.
2 'Jumping the Bite' for the mandible.
3 Camouflage through dentoalveolar compensation.

Each of these solutions can be carried out by a variety of orthodontic appliances.

Dental standard solutions

The default dental key problem consists of space deficiency in the apical base. To enlarge the apical base there are three standard solutions possible, presented in the order of their preferred application:

1 Distal movement of the last molars.
2 Expansion of the dental arch.
3 Reduction the dental surplus by extraction or by stripping.

Each of these solutions can be carried out by a variety of orthodontic appliances.

Functional standard solutions

The default functional key problem is defined by a deviation from a smooth movement from the mandibular rest position into a centric occlusion and a (central?) relation of the lower and upper jaw being not in conflict with the integrity of the musculature. The possible solutions are:

1 Change of the jaw relationship.
2 Change of the position of teeth.
3 Change in the dynamics of the lower jaw.

Each of these solutions can be carried out by a variety of surgical, orthodontic or prosthodontic measures.

Strategic planning

After the checklists are processed and key problems are chosen, one for each level, three standard solutions appeared possible for each key problem. It is the goal of the strategic panning to select one solution of the three possible ones for each key problem and to combine them into one appliance. It is obvious that the dental student has less to offer in the strategic planning than has the graduate student, yet both have gained enormously since we introduced this structured diagnostic procedure.

Conclusion

In our experience, the real advantage of the diagnostic procedure lies in the structured organization that serves as a GPS system for student and teacher and enables them a clear communication about where they are and what has to be done. By design, treatment options have taken priority over treatment mechanics with the result that even the novice feels comfortable in the orthodontic seminars. We are confident that our students are well prepared for their orthodontic future.