



## CURRENT METHODS TO ASSESS THE OPTIMAL ORTHODONTIC REFERRAL TIMING DURING THE GROWTH PERIOD

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### ABSTRACT

Anthropological studies show that in recent centuries the prevalence of dento-maxillary anomalies has increased several times in the general population. Depending on the type and the severity of the dento-maxillary anomaly, its clinical signs may be evident on children even from the period of the temporary or early mixed dentition. The practitioners who have the main responsibility to identify and refer the patients to orthodontic evaluation are frequently the general dentist and the pedodontist. One of their clinical task is to identify those children who would need and benefit from the early orthodontic intervention, in order to prevent the deterioration of their oral health condition. In particular, skeletal facial anomalies need an early diagnosis to prevent their evolution toward severe facial malformations. In such cases, the timely establishment of the orthodontic treatment allows the use of the body's growth potential in the sense of correcting the dento-maxillary anomaly, and often reduces the need for complex treatments in adolescence or adulthood. The scientific literature offers several guiding principles for assessing the need of orthodontic treatment by the general practitioners as part of routine patient assessment. The present review comprises the main methods of analysing the indications of orthodontic consultation at the age of growth.

**KEYWORDS:** orthodontic referral, malocclusions, treatment need indexes, early orthodontic treatment.

### INTRODUCTION

The prevalence of dento-maxillary anomalies in particular populations shows wide variations during the last century. A large scale national survey of health care problems and needs in the United States concluded that more than half of the population have at least moderately irregular (usually crowded) incisors, and that only 30% at most have Angle's normal occlusion.<sup>[1]</sup> In a study conducted on dental casts of patients with class I malocclusions, Daoud et al. found that only twenty-four percent of maxillary arches and 40% of mandibular arches were normally aligned.<sup>[2]</sup> As consequence, the number of patients who need orthodontic treatment is permanently increasing. Despite the high prevalence of malocclusions in children, in practice this clinical condition is often overlooked or underestimated.<sup>[3]</sup>

The orthodontic treatment is a complex biological process, involving important changes of jaws, facial bones, teeth and soft tissues. According to Proffit et al.,

there are three main reasons to initiate orthodontic therapy: social discrimination because of facial appearance of the child; impairments of oral functions (difficulties in jaw movement, mastication, swallowing, speech, temporomandibular joint dysfunction); and increase susceptibility to trauma, gingival diseases, dental caries.<sup>[4]</sup>

Epidemiological surveys indicated an important variation in the judgment of need for treatment, and different thresholds for orthodontic referrals were reported within general dental services.<sup>[5]</sup> Accordingly, the timing of the first orthodontic appointment is presented differently by some authors. As Moimaz et al. pointed out, periodic orthodontic visits should start early, in this way the orthodontist being able to motivate the patient to eliminate functional risk factors and to reduce the risk of developing malocclusions.<sup>[6]</sup>

Slavicek advocated that the clinical orthodontic evaluation of growing children should be performed every six months after 4 years of age.<sup>[7]</sup> This approach has two potential advantages: the child is used to come into the orthodontic office, and the orthodontist has the chance to discover a potential need for interceptive treatment.

The American Association of Orthodontics recommends that the first orthodontic check-up of children should take place no later than age 7.<sup>[8]</sup> By that age, the jaw development and the first permanent teeth eruption sequence permit the specialist to establish a proper orthodontic diagnose and to recognize the necessity of an interceptive treatment.

Dowsing and Sandler appreciate that, for most patients, the appropriate time to receive a full orthodontic assessment is in the late mixed dentition.<sup>[9]</sup> In authors opinion, a definitive orthodontic treatment diagnose and treatment plan can't usually be formulated until a premolar or canine is present in all four quadrant of the mouth (on average, 10 years old for girls and 11 years old for boys).

Orthodontic treatment demands are determined by the presence of certain malocclusion traits, but also by psychosocial and facial considerations. Therefore, a series of difficulties are encountered on the process of assessing an individual need for orthodontic therapy.

Indicators of orthodontic treatment needs were proposed since 1970s, in an attempt to score and standardize the malocclusions evaluation and to offer the practitioners a useful guide to refer as early as possible those patients who would benefit from orthodontic treatment. The indices for screening potential patients were not widely accepted until last decades.<sup>[10]</sup>

Currently, several clinical scales are available to express the orthodontic need for treatment: the Index of Orthodontic Treatment Need, the Treatment Priority Index, the Dental Aesthetic Index, the Index of Complexity Outcome and Need.<sup>[11-14]</sup>

### Index of Orthodontic Treatment Need (IOTN)

Since its development by Brook and Shaw in the United Kingdom, the IOTN is still one of the most used scale in epidemiological surveys and public health policies. The IOTN assesses the need for orthodontic treatment according to the highest potential risk to the integrity of the teeth or supporting structures from the malocclusion. This index offers the benefit of placing the patients in five useful grades, from "no need to treatment" to "extreme treatment need". These grades usually correlate well with clinician's judgements of need for treatment. The index comprises a dental health component (DHC), assessing the occlusion and teeth alignment, and an aesthetic component (AC), resulted from comparison of patient's dental appearance to standard photographs. According to clinicians' opinions, the results provided by the evaluations of a patient through the two components of the index correlate surprisingly good.<sup>[15]</sup>

The dental health component ranges the detrimental effects of various malocclusion traits in order of severity (Table 1).

The aesthetic component of this index was adapted from the Standardised Continuum of Aesthetic Need (SCAN) Index.<sup>[16]</sup> The need for treatment can be determined after the eruption of permanent teeth, by grading the dental attractiveness of the anterior teeth (Table 2). The Aesthetic Component represents a useful tool in patients' communication, helping to explain them the severity of their malocclusion when compared to others.

**Table 1: The DHC component of the IOTN (modified from Jawad et al. and BOS Quick Reference Guide).<sup>[17,18]</sup>**

|                                           | Missing                                                                                                                                                                                 | Overjets                                                                                                                                                                                                 | Crossbites                                                             | Displacement of contact points                                                  | Overbites/open bites                                                         |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| <b>Grade 5<br/>Extreme Treatment Need</b> | <b>5h.</b> extensive hypodontia (more than 1 tooth missing/quadrant) + restorative implications<br><br><b>5s.</b> submerging primary teeth<br><br><b>5i.</b> impeded eruption/impaction | <b>5a.</b> overjet over 9 mm<br><br><b>5m.</b> reverse overjet more than 3.5 mm + masticatory and speech difficulties<br><br><b>5p.</b> defects of cleft lip and palate and other craniofacial anomalies |                                                                        |                                                                                 |                                                                              |
| <b>Grade 4<br/>Severe Treatment Need</b>  | <b>4h.</b> less extensive hypodontia + orthodontic treatment for pre-restorative or space closure                                                                                       | <b>4a.</b> overjet = 6.1-9 mm<br><br><b>4b.</b> reverse overjet more than 3.5 mm with no masticatory and speech difficulties                                                                             | <b>4c.</b> crossbites + more than 2 mm discrepancy between RCP and ICP | <b>4d.</b> contact point displacement >4 mm<br><br><b>4t.</b> partially erupted | <b>4e.</b> lateral or anterior open bite >4 mm<br><br><b>4f.</b> increased + |

|                                                                |  |                                                                                             |                                                                      |                                                                                    |                                                                                                                         |
|----------------------------------------------------------------|--|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
|                                                                |  | <b>4m.</b> reverse overjet = 1.1-3.5 mm with masticatory and speech difficulties            | <b>4l.</b> posterior lingual crossbite                               | teeth, tipped and impacted against adjacent teeth<br><b>4x.</b> supplemental teeth | complete overbite + gingival or palatal trauma                                                                          |
| <b>Grade 3<br/>Moderate/<br/>Borderline<br/>Treatment Need</b> |  | <b>3a.</b> overjet = 3.6-6 mm + incompetent lips<br><b>3b.</b> reverse overjet = 1.1-3.5 mm | <b>3c.</b> crossbite + 1.1-2 mm discrepancy between RCP and ICP      | <b>3d.</b> contact point displacement 2.1-4 mm                                     | <b>3e.</b> lateral or anterior open bite = 2.1-4 mm<br><b>3f.</b> increased + complete overbite with no gingival trauma |
| <b>Grade 2<br/>Mild/<br/>Little Treatment Need</b>             |  | <b>2a.</b> overjet = 3.6-6 mm + competent lips<br><b>2b.</b> reverse overjet = 0.1-1 mm     | <b>2c.</b> crossbite with up to 1 mm discrepancy between ICP and RCP | <b>2d.</b> contact point displacement 1.1-2 mm                                     | <b>2e.</b> lateral or anterior open bite = 1.1-2 mm<br><b>2f.</b> increased overbite >3.5 mm and no gingival contact    |
| <b>Grade 1<br/>No Treatment Need</b>                           |  |                                                                                             |                                                                      | minor irregularity                                                                 |                                                                                                                         |

**Table 2: The AC component of the IOTN: levels of dental attractiveness on a scale of 1-10 (modified from Jawad et al.).<sup>[17]</sup>**

| Treatment Need | Score  |
|----------------|--------|
| Definite Need  | 8/9/10 |
| Moderate Need  | 5/6/7  |
| Slight Need    | 3/4    |
| No Need        | 1/2    |

#### The Risk of Malocclusion Assessment (ROMA) Index

The IOTN was proposed for patients with full permanent dentition, but it is also used for children in mixed dentition. In these cases, the assessment of treatment need is only based on severity of malocclusion, without regarding the age, dentition period and growth spurts.

Russo and coworkers proposed a new evaluation index (the ROMA Index), as a tool to assess orthodontic treatment need in paediatric patients, derived from the dental and occlusal parameters of DHC with the addition of items related to skeletal and functional problems of patients.<sup>[19]</sup> The authors of this classification considered that in growing patients it is important not only to identify the individuals needing to be treated, but also to range the evolutive behaviour of signs and symptoms of their malocclusions.

The ROMA Index evaluates malocclusions in children, taking into account that during the growth period some elements may change under the positive or negative effect of craniofacial development. The ROMA Index also offers informations related to the timing of referral,

which could be immediate or it can be delayed to a different time of patient's growth according to the estimated risk.<sup>[20]</sup>

This clinical guide uses the most severe characteristic identified in a particular patient and categorises the patient on the index risk factor scale according to this most severe item. The ROMA Index comprises five grades, ranked in order of severity, indicating the level of urgency for orthodontic therapeutic intervention.

**Grade 5 – Extreme Risk:** this category includes patients with congenital facial malformations and major systemic malformation syndromes. Orthodontic, and frequently interdisciplinary treatment, is required as soon as possible, therefore these patients must receive immediate referral.

**Grade 4 – Great Risk:** this category includes patients with systemic problems (postural/orthopaedic problems, medical/auxological problems/hereditary tendency for malocclusions), major craniofacial malformations (facial or mandibular asymmetries/articular dysfunctions/craniofacial traumas/skeletal sagittal discrepancies/mandibular hypo- or hiperdivergence) and alterations of the occlusion (scissor bite/crossbite/mandibular displacement/open bite/hypodontia). These patients would benefit from early orthopaedic therapy and orthodontic interventions; they must receive orthodontic referral as soon as possible.

**Grade 3 – Moderate Risk:** this category includes patients with non-severe alterations in dental and/or skeletal relationships (including caries and early loss of deciduous dentition), but these alterations tend to persist and sometimes worsen with growth. These cases would require orthodontic treatment combined with orthopaedic-functional therapy. The orthodontist will choose the timing of intervention on the active growth phases of the affected areas, therefore it is important that these patients receive referral for orthodontic surveillance.

**Grade 2 – Mild Risk:** this category includes patients with controllable risk factors, with limited effect on craniofacial development. This section quantifies for the first time the risk for malocclusion onset represented by the permutation abnormalities, poor oral hygiene, functional asymmetries, bad habits and oral respiration. The patients with grade 2 require orthodontic monitoring and preventive interventions to ensure proper craniofacial development.

**Grade 1 – Minimum Risk:** this category includes patients for whom no predisposing conditions to malocclusion are detected at the time of clinical examination. The developing occlusion of these children must be monitored in the general dentist's office in order to detect promptly possible pathology.

The results provided by the study of Grippaudo and coworkers proves that this index makes malocclusion risk assessment possible even for general practitioners when first examining a patient.<sup>[20]</sup> The ROMA Index is considered easy to apply, reproducible, reliable and sensitive in identifying dento-skeletal problems. The authors of the study recommend its use as a substitute to IOTN (DHC) in cases of growing children in deciduous and mixed dentition.

### **The Baby - Risk of Malocclusion Assessment (ROMA) Index**

Derived from the ROMA Index, the Baby-ROMA Index is an orthodontic treatment needs index appropriate for orthodontic screening in children aged between 2 and 6 years, in complete deciduous or early mixed dentition. This index is intended for preschoolers, taking into consideration systemic, skeletal, dental, and functional problems.<sup>[21]</sup>

The Baby-ROMA Index is divided into four main categories of problems: systemic, craniofacial, dental and functional. Each category includes different parameters of malocclusions and their severity scores (from 5 to 1). Given the age of children, some malocclusion parameters received different severity scores than in the ROMA Index: postural, auxological problems and possible inheritance of malocclusion are assessed with a low risk score of 2 (instead of 4); maxillofacial traumas have a high score (5) if they are complicated with condylar fracture; class III malocclusions receive higher score (4

instead of 3 or 2); class II malocclusions are assessed with lower score (2/3, instead of 3/4); open bite, overbite, hypodontia and mandibular displacements present lower scores; supernumerary teeth, caries and early loss of deciduous teeth have score 4.

The scores of the Baby-ROMA Index give similar indications as the scores of the ROMA Index regarding orthodontic treatment timing; scores of 4 and 5 require an immediate orthodontic referral; score of 3 indicates the presence of a malocclusion which can persist or worsen, therefore patients will receive orthodontic referral for specialist assessment; score 2 is exposed to the action of risk factors, therefore patients receive referral for orthodontic monitoring; scores of 1 need routine check-ups in dental office to monitor the occlusion.

Using the Baby-ROMA Index in a transversal observational study on 1405 children between the ages of 2 and 7, Grippaudo and coworkers detected that over 50% of the children had a high degree of risk or already had a malocclusion that could worsen over time (grade 4). In the absence of the clinical use of this guided evaluation, it is possible that some of the malocclusion traits would have remain undetected.<sup>[22]</sup>

A cross-sectional study conducted on 1000 children aged 4–6 in Kerman (Iran) kindergartens proved that the Baby-ROMA index exhibited good reliability and ease of use for evaluating early orthodontic treatment needs in primary and mixed dentitions.<sup>[23]</sup>

### **DISCUSSION**

“Prevention is the first strategy of contemporary medicine that must be applied to reduce the prevalence of diseases and reduce the biological costs and expense of health treatments”.<sup>[24]</sup>

In the field of orthodontics and dento-facial orthopaedics, a great benefit for growing children, especially during early mixed dentition, is represented by the early interception of bad habits, by the oral breathing therapy, by the interceptive orthodontic treatment of recently appeared malocclusions. As R. M. Ricketts stated, “the early you treat, the more the face adapts to your ideal; the late you treat, the more you have to adapt to the face”.<sup>[25]</sup> Initiating the early orthodontic treatment on severe skeletal discrepancies offers the advantage of dealing with mild malocclusion alterations and the possibility of conducting the body growth potential toward developmental correction.

One of the problems raised by early orthodontic treatment is the possibility of diagnosing a child with severe malocclusion on the appropriate time. The study conducted by Di Blasio and coworkers on 540 consecutive patients referred to an orthodontic office concluded that most of the referral reasons were related to aesthetic dental impairments, while many skeletal

discrepancies of patients were not included in the referral letters. The authors concluded that, in practice, a real risk exists that only evident dental problems are addressed to an orthodontic consultation, while craniofacial growth problems would remain underdiagnosed.<sup>[26]</sup>

Letters of referrals from general practitioners can be made to specialist orthodontic practices and to the hospital orthodontic service. Specialists from orthodontic offices frequently accept patients who require routine orthodontic treatment aimed to crowding, increased overjet and overbite, posterior and anterior crossbites, mild hypodontia. Patients who require interdisciplinary treatment, patients with cleft lip and palate or other craniofacial abnormalities, and children with physical or mental handicap are usually accepted for treatment on dental hospitals and interdisciplinary clinics.<sup>[27]</sup>

Prior to referral, the general dental practitioner is advised to also evaluate the patient motivation for orthodontic treatment, giving the specific requirements of this therapy. Patients with poor oral hygiene or active caries should be referred to consultation after the oral situation is corrected, unless an orthodontic emergency is concerned.<sup>[9]</sup> Clinical studies have shown that a series of referred patients refused orthodontics for perceived handicapping malocclusions, while others desired to undergo treatment for minor dental alterations.<sup>[16, 28]</sup>

## CONCLUSION

The routine clinical use of the above-mentioned Indexes of Orthodontic Treatment Needs (IOTN, ROMA and baby-ROMA, according to the dentition type) in dental practices permits an individual and unitary evaluation of the growing children. Carefully monitoring all young patients, they can be referred for an orthodontic opinion at the right time. The proper selection of the optimal referral timing offers benefit for both the patient and for the specialist.

## AUTHORS' CONTRIBUTIONS

All authors contributed equally to this paper.

All authors read and approved the final version of the manuscript.

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