



Cervical Vertebral Index (CVM) and Middle Phalanx Maturation Index(MPM): assessment of optimal treatment timing in orthodontics

Peer review status:

No

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Article ID: WMC005366

Article Type: Systematic Review

Submitted on: 08-Nov-2017, 03:59:09 PM GMT **Published on:** 10-Nov-2017, 09:02:53 AM GMT

Article URL: http://www.webmedcentral.com/article_view/5366

Subject Categories: ORTHODONTICS

Keywords: Cervical vertebral index, skeletal maturation, middle phalanx maturation, puberal growth spurt

How to cite the article: Favale M, Di Luzio C, Caputo M, Bellisario A. Cervical Vertebral Index (CVM) and Middle Phalanx Maturation Index(MPM): assessment of optimal treatment timing in orthodontics. WebmedCentral ORTHODONTICS 2017;8(11):WMC005366

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Source(s) of Funding:

No fund has been taken

Competing Interests:

None

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Abstract

The purpose of this review is to analyze two different type of growth index and their use in orthodontic practice.

Introduction:

CVM index and MPM index are the most used in order to take advantage from pubertal growth spurt in the orthopedic and orthodontic treatment.

Material and Method: For this review scientific articles published in data-base among which Pubmed, EMBASE, Medline, DynaMed Plus and Cochrane Library have been taken into account. No restriction of languages or time is been set.

Discussion: The MP3 and CVM method are positively correlated, which suggests that either of them can be used with the same confidence in assessing the skeletal maturity.

Conclusion: The evaluation of growth spurt is most important to performing orthodontic treatment in growing patient. Relying upon maturational stages of cervical vertebrae for assessing the skeletal age may be advantageous over MP3, thus eliminating the need for an additional radiograph.

Introduction

Frequently it is important to establish the stage of maturation and development in patient who needed of an orthodontic treatment in order to decide the better option in a specific period. Indeed some type of orthodontic treatments have better results if their application is close the pubertal growth spurt [1-2]. Chronological age is not considered a reliable method to determine the biological maturity, so other indicators are been suggested to asses the development stage [6-7].

Several indices have been proposed to identify the skeletal maturation phases [1-3]; the Cervical Vertebral Index (CVM) and third Middle Phalanx Maturation (MPM) index are the mostly used especially in orthodontic; CVM and MPM are

radiography-based indices.

There are many studies about the comparison of these two indices; but only few studies [4-5] have specifically been focused on the correlations between the middle phalanx maturation (MPM) of the third finger and the cervical vertebral maturation(CVM).

The MPM method is based on a carpal radiograph and it evaluate the skeletal changes that occur in the hand and wrist region, including the gradual appearance of carpal bones and changes in fusions among epiphyses and diaphyses of the phalanges[8]. This kind of radiograph it is not included in the orthodontic documentation, therefore it represents an additional x-ray exposure for the patient.

The interest in the growth and variation of the cervical vertebrae starts in the early 1900s, when Todd, Pyle and then Lanier began to evaluate their size and form changes.

Indeed cervical vertebrae are in continuing changed during the development.

Lamparsky, of Pittsburg University, developed a system to classifying the different stage of maturation, in relation to the radiograph of wrist. Other author such as Hasser, Farman, Sanchez and Szyska developed a more precise index based on the variation of the second, third and fourth cervical vertebrae.

In 2002 Franchi, Baccetti and McNamara proposed an improved approach to evaluating the maturation of cervical vertebrae (CVM).

The characteristics of an ideal radiographic index are

- I. Biological validity in describing skeletal maturity;
- II. It must be effective in detecting mandibular growth spurt;
- III. It may not require further X-ray exposure

Human growth is influenced by many different factors: genetic, epigenetic, social and behavioral.

The studies that have analyzed the relationship between these two methods [8] generally reporting a high degree of correlation.

Middle phalanx maturation (MPM) method

The MPM method includes 6 stages. Definitions of the stages were based on previous descriptions by

Fishman [4], Hagg and Taranger [9], Rajagopal and Kansal [12].

MPS1:

When the epiphysis is smallest than the metaphysis, or it is as wide as metaphysis, but with both tapered and rounded lateral borders. Epiphysis and metaphysis are not fused. This stage described to be attained more than 1 year before the onset of the pubertal growth spurt.

MPS2:

When the epiphysis is at least as wide as the metaphysis with sides increasing thickness. This is the stage 1 year before pubertal growth spurt.

MPS3

When the epiphysis is either as wide as or wider than the metaphysis (5) with lateral sides showing an initial capping toward the metaphysis. Epiphysis and metaphysis are not fused. This stage coincides with pubertal growth spurt.

MPS4

When the epiphysis begins to fuse with the metaphysis; although contour of the epyphysis is still clearly recognizable. This stage identify an overstep of pubertal growth spurt, indeed the curve of growth is in deceleration.

MPS5

When the epiphysis is mostly, but not completely fused with the metaphysis, and the distal contour of epiphysis begins to be less clearly recognizable. The pubertal growth spurt in this stage is at the end.

MPS6

When the epiphysis totally fused with the metaphysis, and the distal contour of epiphysis is not recognizable. In this stage the pubertal growth spurt is at the end.

Cervical vertebral maturation method

This method comprises 6 stages.

CS1

When the lower borders of the second, third, and fourth vertebrae (C2, C3, and C4) are flat, and the bodies of C3 and C4 are trapezoid in shape. This stage is about 2 years before pubertal growth spurt.

CS2

When the lower border of C2 is concave and the bodies of C3 and C4 are trapezoid. This state has been reported to be attainder 1 year before growth spurt.

CS3

When lower border of C2 and C3 have concavities,

and the body of C3 and C4 are either trapezoid or rectangular horizontal. This stage coincides with pubertal growth spurt.

CS4

When the lower borders of C2 and C4 have concavities, and the bodies of both C3 and C4 are rectangular horizontal. This stage has been described to be attained at coincidence of the pubertal growth spurt, but after the peak height velocity, that is, during the deceleration curve of growth.

CS5

When the lower borders of C2 and C4 have concavities, and at least one or both of the bodies of C3 and C4 is square. This stage has been reported to occur 1 year after growth spurt.

CS6

When the lower borders of C2 and C4 have concavities, and one or both bodies of C3 and C4 are rectangular vertical. Growth spurt happened 2 years before.

Material and method

To realize this review, a systematic research in literature has been performed with no language or time restriction. In order to identify relevant studies in data base such as Pubmed, EMBASE, Medline, DynaMed Plus, Cochrane Library and Web of Science.

Keyword used were "*cervical vertebrae index*", "*skeletal maturation*", "*middle phalanx maturation*" and "*pubertal growth spurt*".

Studies with samples made by illness patients, abstracts, opinion articles, commentaries and editorials has been removed. Initial research comprising more than 150 articles, at the and only 20 articles are been selected.

Discussion

In a comparative study [13] Perinetti found a diagnostic agreement between the different stages of maturation of the middle phalanx of the third finger and the cervical vertebral on a population of Caucasian growing subjects.

CVM method has been correlate to biomarkers of growth and at the same time with statural growth and mandibular growth spurt [14-3]. The CMV validity is confirmed by a randomized clinical trial concerning the functional treatment of growing patient [17]. In the

same way, many studies confirm the correlation between MPM method and statural or mandibular growth.

In order to establish the better time for orthodontic treatment must be made prevision pubertal growth spurt; in this way it is possible to have the maximum skeletal effect in less time of treatment.

In ambiguous cases MPM method could be useful in addition to CVM method.

A functional appliance show better results when the patient is during CS3-4 or MPS3-4;

Therefore vertebral index should be considered a routine evaluation in the planning of a therapy because the head lateral radiograph is already available in orthodontic documentation, and in such way it is possible to avoiding additional x-ray exposition.

The CS3-4 interval and the peak in standing height show similar but variable accuracy in the identification of the mandibular growth spurt; both the CS3-4 interval may be used in routine clinical practice to enhance efficiency of treatments requiring the inclusion of the mandibular growth spurt in the active treatment period [22-24].

Early treatment normalizes the skeletal pattern, reduces the length of treatment in the permanent dentition, leads to a reduction of overjet and overbite, improves functions and gets more stable results [18-19-20].

Growth modulation by functional appliances helps to increase the growth of a deficient jaw and/or to restrict the excessive growth of the jaw. Thus, in properly diagnosed and managed cases, they can be very efficient tools to reduce the skeletal discrepancy and prevent futuristic complex orthodontic and surgical treatment.

According to Mitani and Sato [21] there is variability in jaw growth, in quantity, direction, speedy, sequence and time. In all of this factors the time is the most important variable for a treatment planning

Conclusions

Several studies show how important is the knowledge of stage of growth in young patient in order to optimize a specific orthodontic treatment.

There is a statistically significant correlation between the two bone maturation indices.

In clinical routine it is recommended to use CVM method referring to lateral head radiograph thus

eliminating the need for an additional radiograph, but it is possible to integrate the data with MPM method if it is necessary.

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