# RAPIDCEPH: A NEW DEVICE FOR ORTHODONTIC SKELETO-DENTAL ASSESSMENT

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#### ABSTRACT

The manual method is the gold standard in cephalometric analysis and will remain the method of teaching the cephalometric analysis for dental student to build strong basic knowledge. This study aimed to introduce the Rapidceph as a newly invented tool and illustrate its use in the assessment of skeleto-dental relationship. The procedure needed for the new method are; Rapidceph, cephalometric radiograph, hand tracing of the skeleton-dental structures. For a direct assessment from cephalometric radiograph, an x-ray viewer is needed for illumination. Rapidceph is a simple, single device that combines several tools put together in one. It allows angular and linear measurements of skeleto-dental model measurements of overjet and overbite, assessment of arch symmetry and visualization of arch form is also possible. The Rapidceph can facilitate teaching and the work of dental students and researchers interested in studying malocclusions and measuring skeleto-dental relationships. It helps in measuring sheleto-dental relationships between different populations.

Key Words: Rapidceph, manual cephalometric, skeleto-dental assessment.

### **INTRODUCTION**

Approved:

Thousands of patients had orthodontic appliances fixed on their teeth all over the world every day. Teeth movement is directed to achieve the best possible harmonious relations between the different skeletal. dental and soft tissue craniofacial structures.<sup>1</sup>The skeleto-dental relationship must be assessed carefully before the start of any orthodontic treatment.<sup>2</sup> Radiographic images of the craniofacial structures were introduced and standardized in 1931.3 The skeleto-dental structures were hand traced, anatomical landmarks were located and linear and angular measurements were recorded between the anatomical landmarks.<sup>4,5</sup> Good knowledge of craniofacial anatomy is required to trace and locate the anatomical landmarks to avoid errors in landmarks identifications.<sup>6-8</sup> The measurements were interpreted for diagnosis, treatment planning, and evaluation of treatment results.<sup>2,9</sup> Cephalometric tracing is achieved by manual and or computerized method, the manual method is considered the gold standard in the cephalometric analysis.<sup>10,11</sup> For a long time, the manual tracing and measurements were the method used in dental education and clinical practice<sup>5,12</sup>, and

Professor of Orthodontics, Department of Pediatric Dentistry and Orthodontics, College of Dentistry, King Saud University. **Correspondence:** Professor Mohammed Tahir Bukhary, P.O. Box 60169, Riyadh 11545 Saudi Arabia Phone: +966 505718329 Email: mtbukhary@gmail.com **Received for Publication:** Aug 20, 2018 **First Revised:** Sep 20, 2018 it will still be the method of teaching in dental schools and colleges to help the students to build strong basic knowledge.<sup>12</sup> The continuous advancements in computerized dental radiology resulted in the development of different methods of imaging the craniofacial structures that eliminate the need for radiographic films and the developing solutions<sup>13,14</sup>, and at the same time more development in the softwares to perform cephalometric tracings, measurements, and analysis.<sup>13-15</sup> At present, the swift movement towards computerization is matched with changes in the dental education, but not in every aspect of teaching. The manual method of teaching in cephalometric analysis is not changed and printed copies from the computerized digital images are distributed to the students and measurement were taken manually.<sup>12</sup> Several researchers have compared the computerized cephalometric measurements against the manual method in anatomical landmarks identification, accuracy, and superiority in diagnosis or prediction.<sup>16-33</sup> The results were controversial, but there was an agreement that the computerized method has the advantage of speed in storing and processing the data<sup>14,34-36</sup> but was not superior in landmark identifications, diagnosis, or prediction.<sup>8,12,33,35</sup> Even with the movement toward computerized digital radiography, teaching the basics in dental institutions still rely on the old method, the gold standard, using ruler and protractors to build the strong basic knowledge before going to the computerized methods. The Rapidceph is

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a new invention of the author, a device that combines several devices in one, aimed to replace ruler and protractor in the assessment of skeleto-dental relationship.

## MATERIALS AND METHODS

The materials needed are Rapidceph, cephalometric radiograph, hand tracing of the skeleton-dental structures, an x-ray viewer for direct assessment of the cephalometric radiograph. The Rapidceph is briefly described below. For more detailed description see the US patent number 8,209,876 B2 "Device and method for measuring the skeletal dental relationship". Date of patent is July 3, 2012. The inventor is Mohammed Taher Bukhary and the Assignee is King Saud University. The Rapidceph is a device invented by the author to measure the skeleto-dental relationships. It combines several instruments in one device. It contains two protractors, dental arch symmetry and three rulers (Figure 1). This innovation is built on the theory of zero point, where all measurements are related to zero point. The zero point of this device is located on the upper right corner, the two identical protractors are superimposed on the zero point. It measures the anteroposterior position of the maxilla, the anteroposterior position of the mandible and the anteroposterior relationship of the skeletal bases. It also measures the angulation of the maxillary incisor to the maxillary plane and the angulation of the mandibular incisor to the mandibular plane. The linear measurements of the skeleto-dental structures are measured by the ruler. The overjet is the horizontal distance between the upper incisor and the lower incisor, whereas, the overbite is the vertical distance between the upper incisor and the lower incisor. The symmetric meter located on the lower right corner of the Rapidceph is for the assessment of the symmetry of the maxillary and mandibular dental arches and visualize the arch form.

# Step by step skeleto-dental assessment:

The anteroposterior relationship of the skeletal bases is measured by superimposing the top zero line to the line of the anterior cranial base registering the zero point at the anatomical N point. The normal anteroposterior position of the maxilla measured at the anatomical point A is between 80° and 82°. Whereas, the normal anteroposterior position of the mandible measured at the anatomical point B is between 78° and 80°. The normal anteroposterior position of the maxilla to the mandible is between 2° and 4°. Figure 2 show the application of the Rapidceph for direct measurement from the Cephalometric radiographs. The vertical relationship of the skeletal bases is measured by superimposing the right zero line to the line of the maxillary base and moving the Rapidceph side to side to measure the vertical relation of the mandible to the maxilla (Figure 3). The normal vertical relation of the mandible to the maxilla is between  $23^{\circ}$  and  $30^{\circ}$ .

The angulation of the maxillary incisor is measured by superimposing the top zero line to the maxillary plane. The normal angulation of the maxillary incisor to the maxillary plane is between 105° and 115°. On the other hand, the angulation of the mandibular incisor is measured by superimposing the right zero line to the mandibular plane FFigure 4. The normal angulation of the mandibular incisor to the mandibular plane is between 85° and 95°.

The linear measurements of the skeleto-dental structures are measured by the ruler. The overjet is the horizontal distance between the upper incisor and the lower incisor, whereas, the overbite is the vertical distance between the upper incisor and the lower incisor. The normal values of the overjet and overbite are 2mm. The overjet and overbite are measured by the two small rulers on the top right corner of the Rapidceph. The 15mm ruler on the lower right side of the Rapidceph is used for any linear measurements of the skeleto-dental structures.

The symmetric meter on the located on the lower right corner of the Rapidceph is for the assessment of the symmetry of the maxillary and mandibular dental arches and visualize the arch form Figure 5. The midline is presented as an extension of the right zero line at 40mm from the right side of the Rapidceph. The right and left symmetry of the dental arch is assessed by the lines extended at 2° interval from the zero point. The vertical symmetry of the dental arch is assessed by the vertical lines extended at 10mm interval from the zeros point of the 15mm ruler. The U-shape structure help to assess and visualize the arch form for archwire selection during orthodontic treatment.

### RESULTS

The application of the Rapidceph for the assessment of skeleto-dental relationships is illustrated. Rapidceph is a simple tool for the assessment of skeleto-dental relationships. Rapidceph is a combination of several tools put together in one tool for the assessment of skeleto-dental relationships. Accuracy is within the range of  $\pm 0.5$  for angular measurements and of  $\pm 0.5$ mm for linear measurements. It allows the measurements of any selected structures in anteroposterior and vertical dimensions such as the anteroposterior position and relation of the maxilla, mandible and anterior teeth, the vertical relation of the mandible to the maxilla. In addition, the Radipceph allows the measurements of overjet and overbite from the dental model, assessment of dental arch symmetry and visualize the arch form for archwire selection during treatment.



Fig 1: The Rapidceph and its components



Fig 2: Direct measurement using x-ray viewer



Fig 3: Anteroposterior measurements of maxilla and mandible



Fig 4: Vertical relation measurement



Fig 5: Upper incisor angulation measurements



Fig 6: Lower incisor angulation measurements

The manual method for teaching the cephalometric analysis is the gold standard in most dental schools, and will remain as signaled by Silva et al.<sup>12</sup> If this is true, the manual method will keep the same position and privilege even with development of computerized methods. It was pointed by Silva et al<sup>12</sup> that printed copies of the digital images are distributed to the students for manual tracing during the teaching classes. It does not matter how advanced the method of taking and processing digital images become, the printed copies are used for manual analysis. It can be said that the computerized craniofacial digital imaging just replaced the radiographic films to printed copies. This is not to deny the massive information provided by 2-D or 3-D images. The Rapidceph is an invented device for the manual assessment of skeleto-dental relationships. It was invented to eliminate the need for the use of different instruments such as ruler, protractor, and the compass during the teaching of cephalometric analysis to the dental students. The use one device should help for more discipline and control of the class during the course of teaching. The manual method of cephalometric analysis is considered the gold standard that requires good basic knowledge in craniofacial anatomy to recognize, identify and locate the anatomical landmarks and then take the necessary measurements. Absolute attention and devotion to the learning process are required from the students and any disturbance or impediment can lead to improper learning. During the session of cephalometric teaching, attention is usually disturbed by other students trying to find the missing ruler or protractor leading to some kind of distraction, and if this happened in every table it will lead to misconducting of the knowledge. It was an idea to find a device that contains all a student needs to perform the cephalometric exercise in one device and later tried on transparent paper and finished in patented device. The Rapidceph is one piece device almost the size of the cephalometric film or A4 paper, simple, handy and performs all the needed measurements for skeleto-dental analysis. Hoping it will find acceptance in the world of orthodontics and a place in the cephalometric teaching and dental education. It can be used as a research tool to compare with other methods of manual analysis or computerized methods. More research is needed to evaluate the reliability and validity of the Rapidceph.

### CONCLUSION

The Rapidceph can facilitate the process of teaching and the work of the dental students, dentists, orthodontist and researchers interested in studying dental malocclusions and measure the skeleto-dental relationships of the human craniofacial structures.

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