

A novel method for three-dimensional tooth axis and alignment using cone-beam computed tomography

【Keywords】

Dentistry

Cone-beam CT

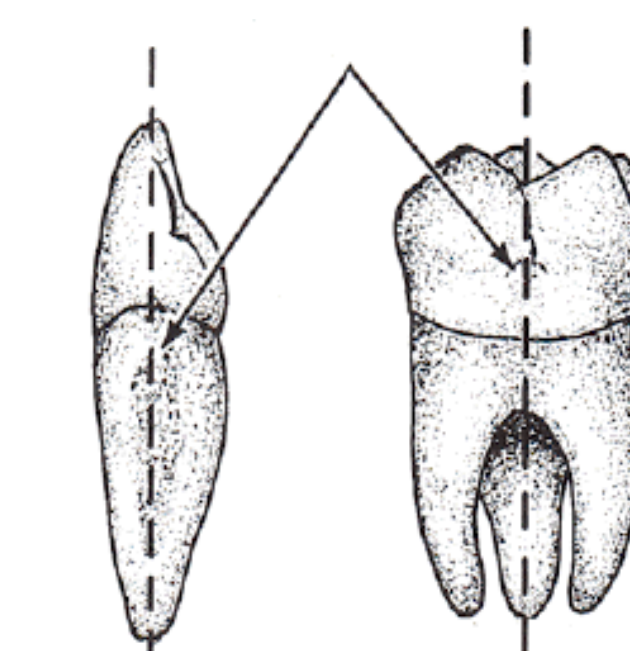
3D jaw and tooth

3D tooth axis

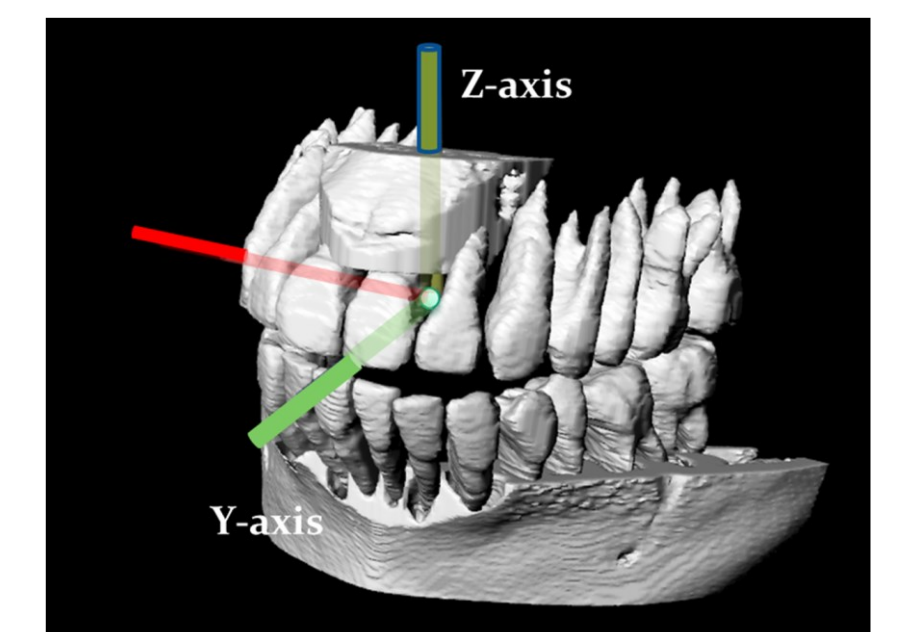
3D tooth alignment

■ Summary

• We developed a global coordinate system based on maxillary and mandibular feature points from 3D reconstructions using in vivo cone-beam computed tomographic (CBCT) image data, devised a procedure for automatically calculating the tooth axis of the maxillary and mandibular anterior teeth and the absolute 3D position of the tooth alignment.



Tooth axis

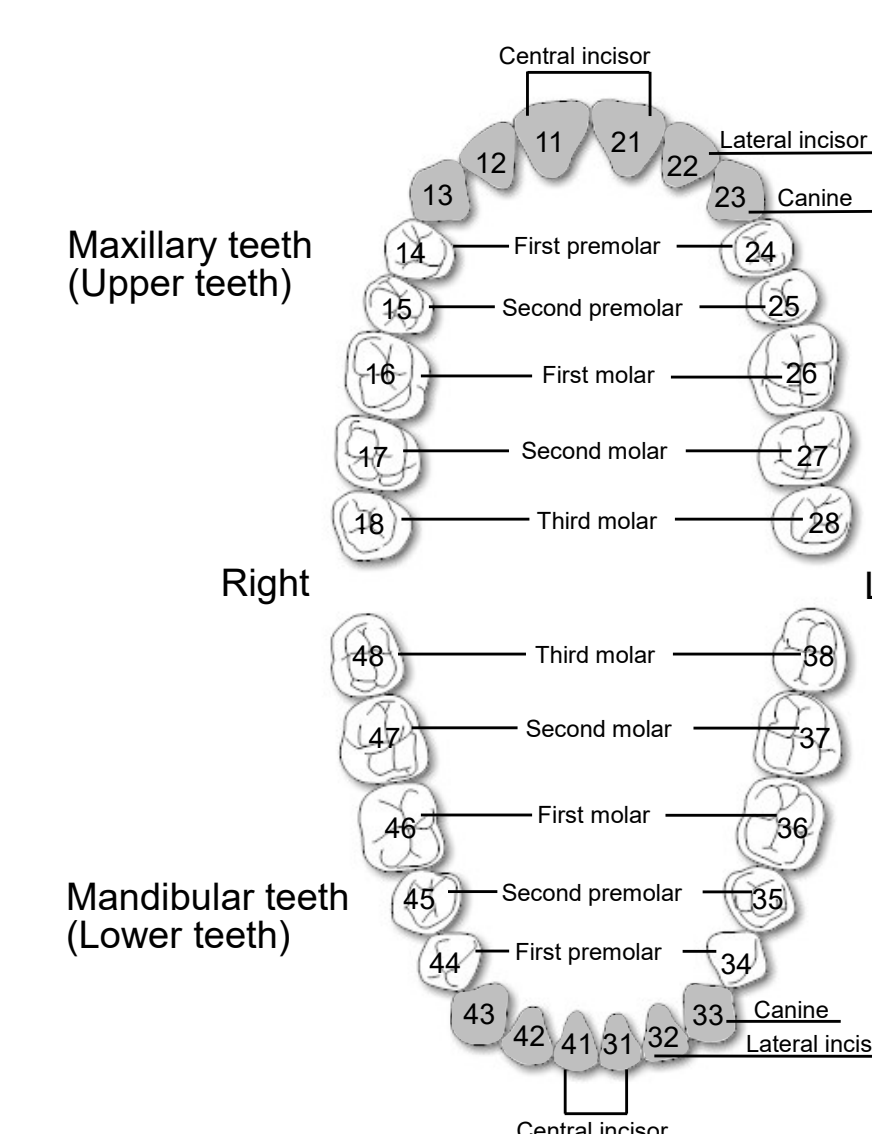


3D model of world coordinate system in the intraoral space.

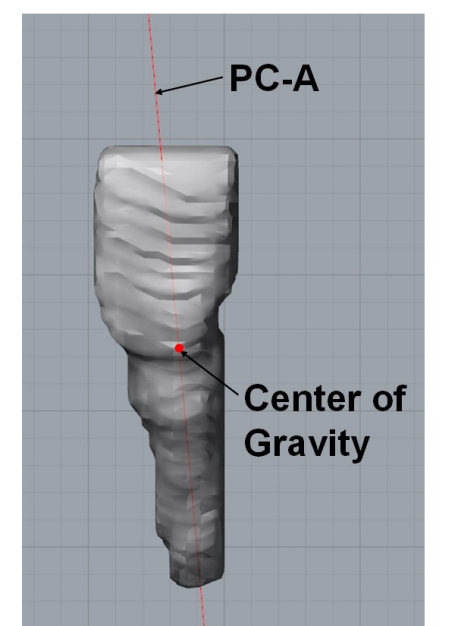
■ Subject Details/Topic

• We used 3D principle component analysis to calculate the tooth axis (PC-A) as the principal component of the long axis direction of tooth from six subjects.

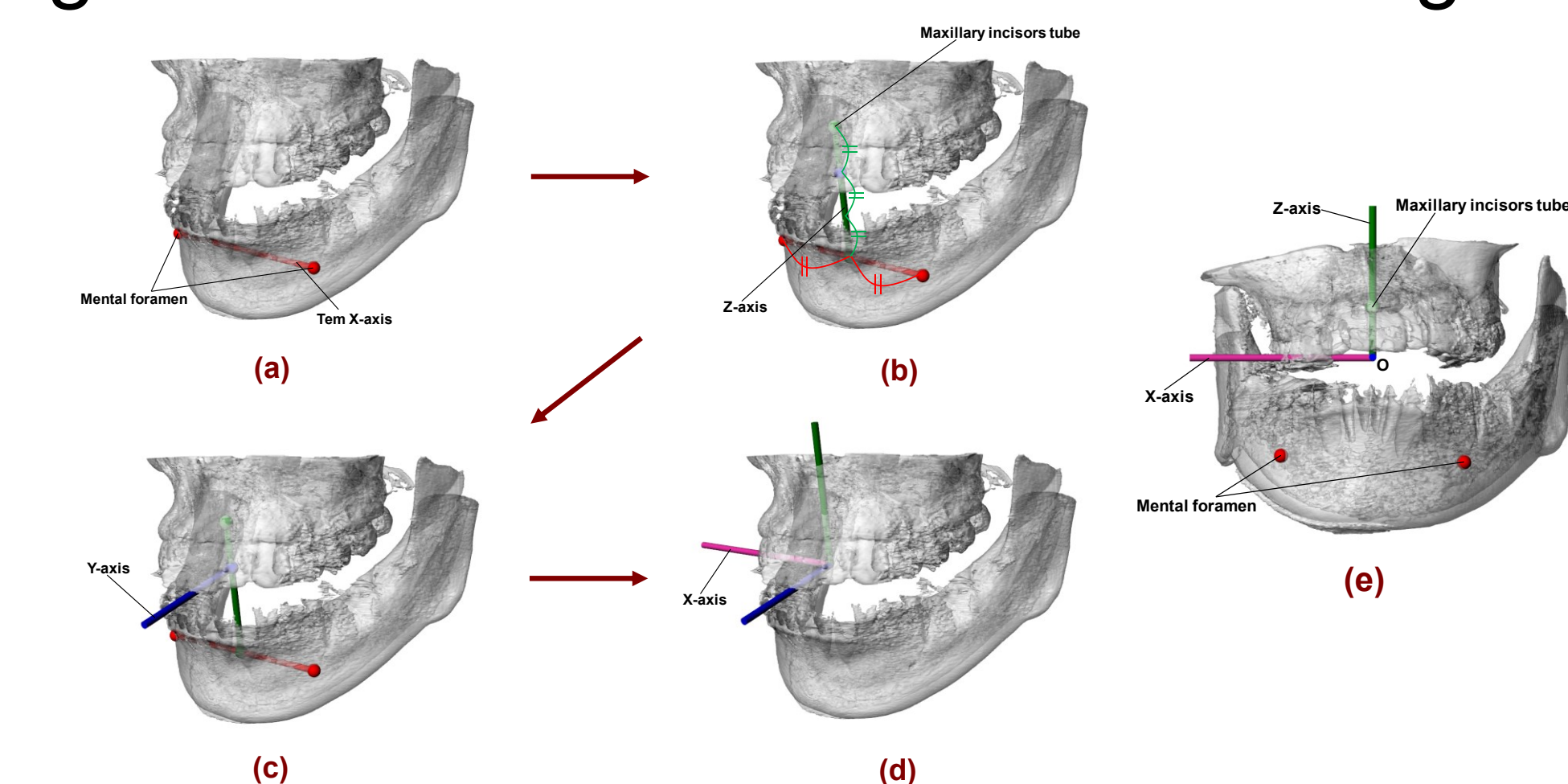
• To evaluate tooth alignment, we determined a 3D global coordinate system using three feature points comprising the bilateral mental foramina in the mandible and the incisive canal in the maxilla by representing 3D tooth alignment in terms of tooth's center of gravity (COG).



FDI dental numbering system for adult teeth. Gray teeth are used in this study.



3D reconstruction model of tooth from CBCT images. Red line represented the principal component analysis-axis: PC-A (#3, 41).



Construction of three-dimensional world coordinate system in the intraoral space.

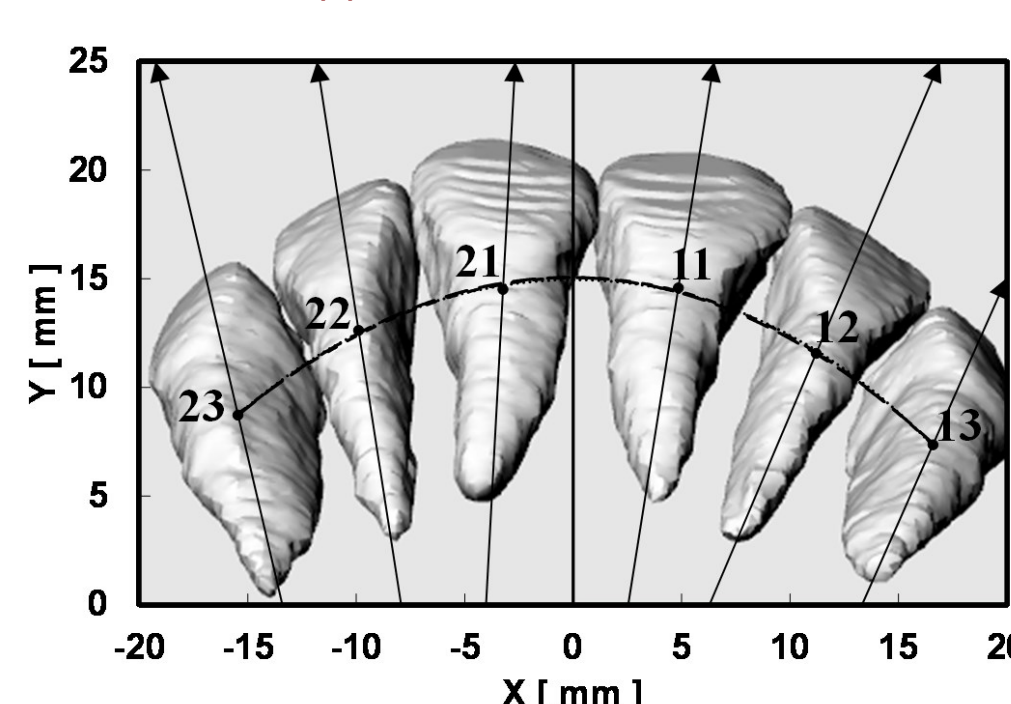
(a) Determination of temporary X-axis (Tem X-axis).

(b) Determination of Z-axis.

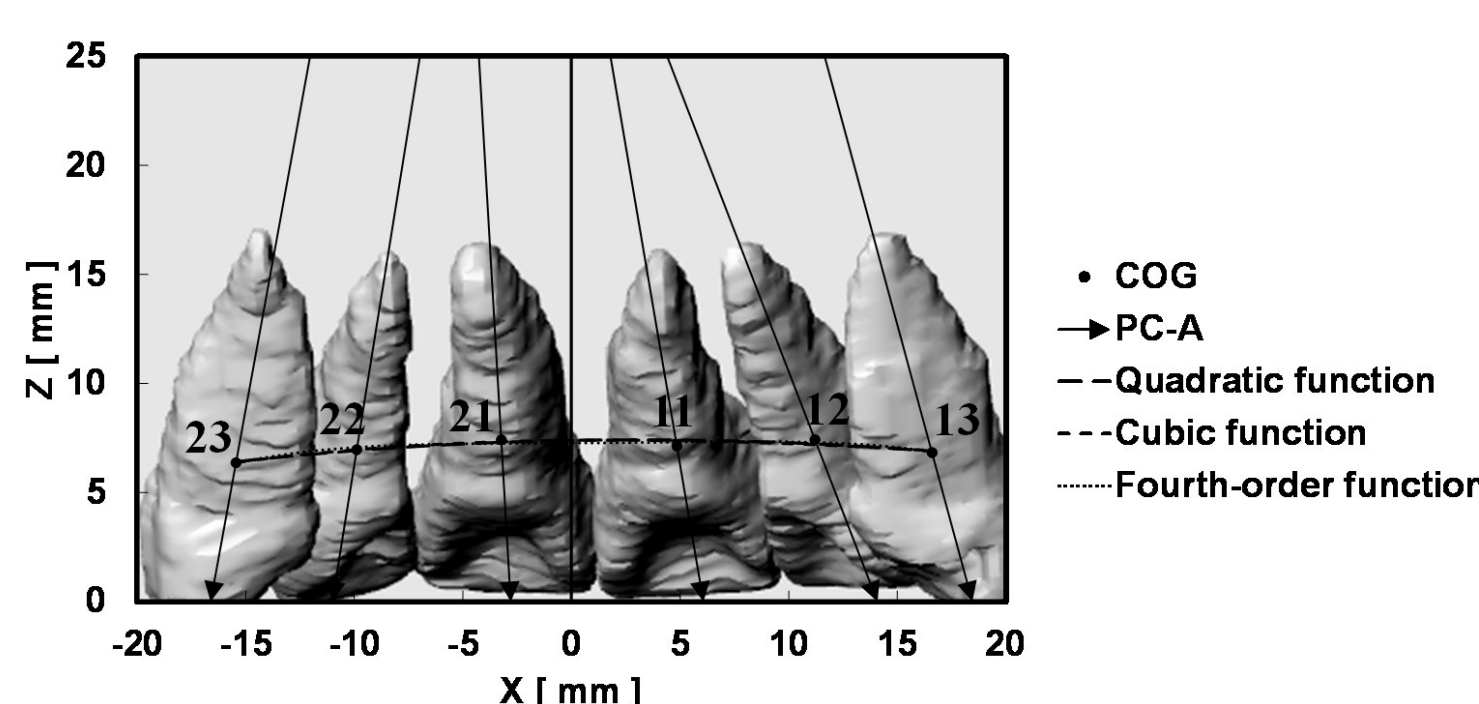
(c) Determination of Y-axis.

(d) Determination of X-axis.

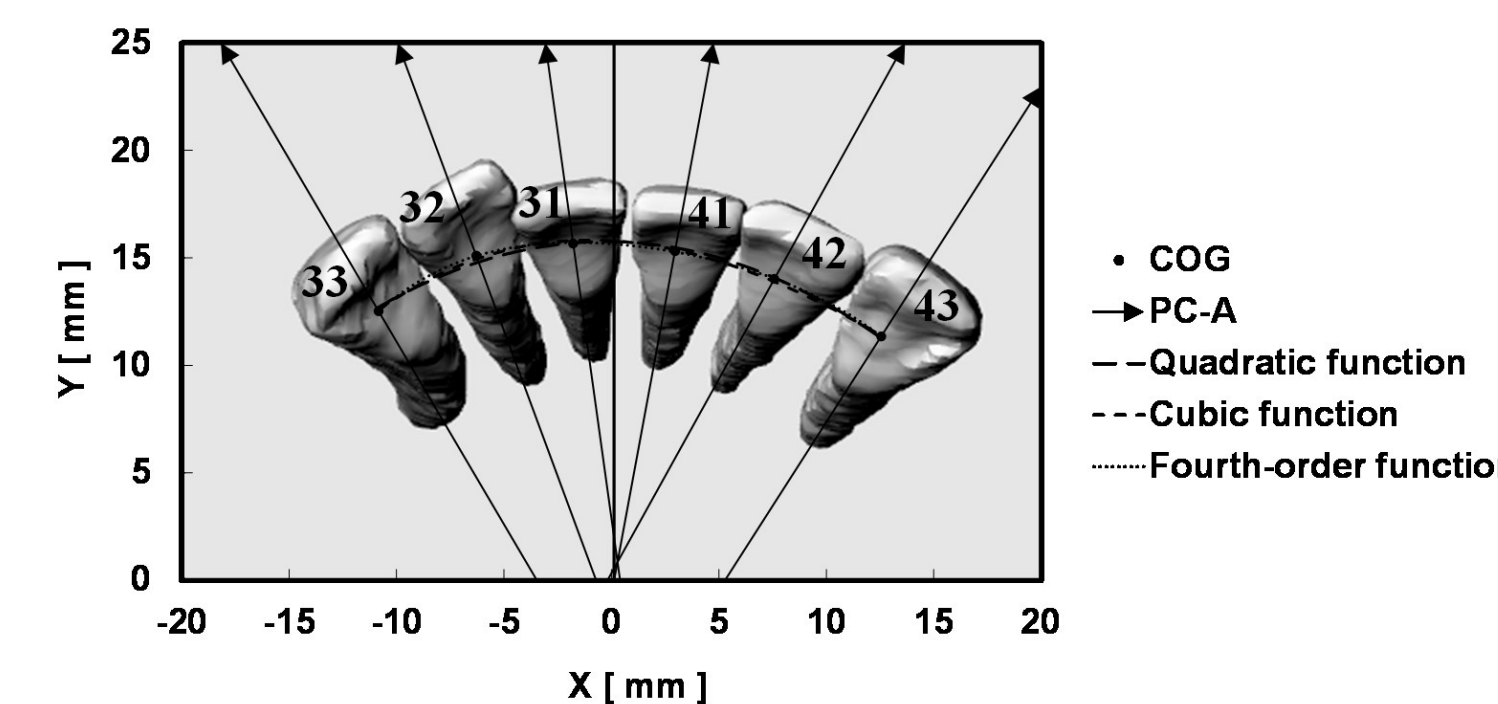
(e) World coordinate system seen from the front of the jaw.



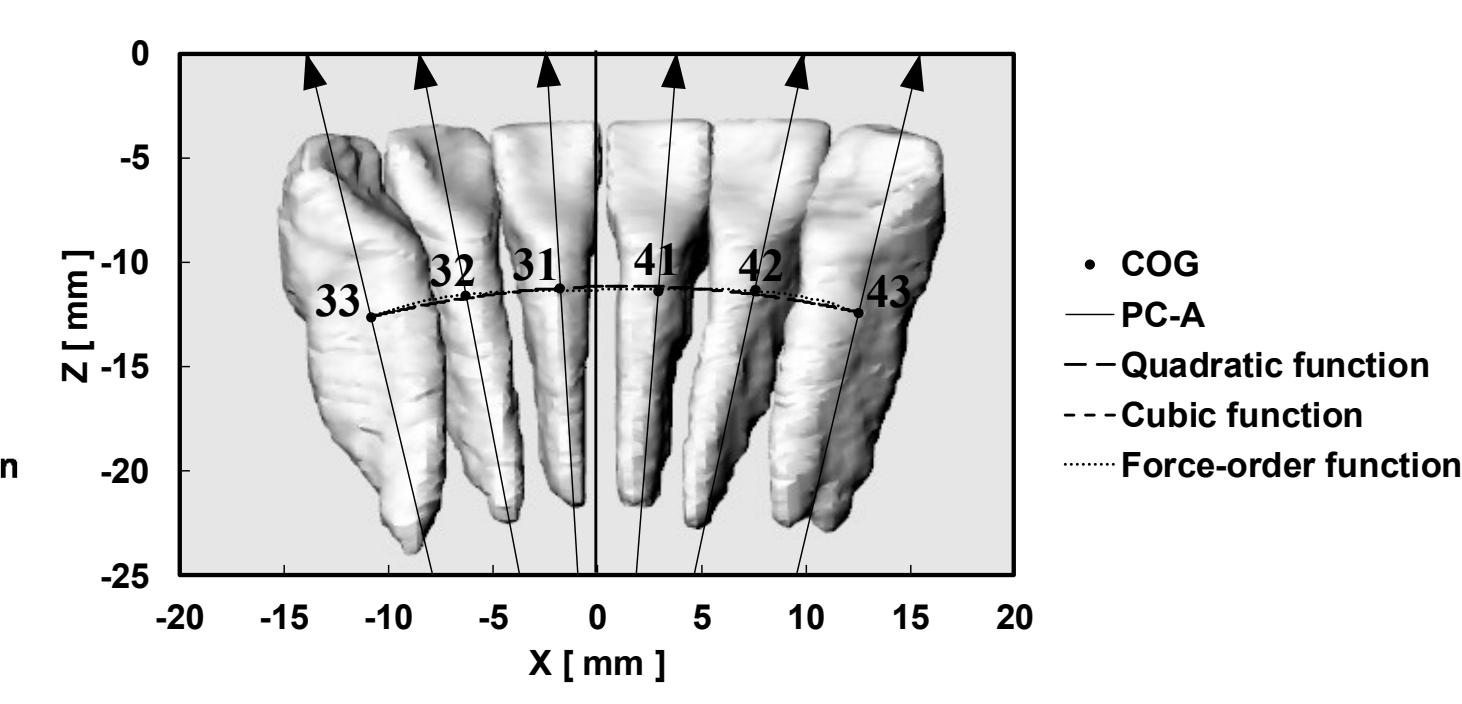
(a)



(b)



(c)



(d)

(a) Typical reconstruction models of maxillary tooth in X-Y plane. (b) Typical reconstruction models of maxillary tooth in X-Z plane. (c) Typical reconstruction models of mandibular tooth in X-Y plane. (d) Typical reconstruction models of mandibular tooth in X-Z plane.

○ Advantages

• Conventionally, tooth alignment is calculated from feature points on the surface of the tooth crown, using ambiguous target points. In comparison, tooth alignment is calculated in our method from the center of gravity of the 3D tooth shape, which gives it the advantage of using unambiguous target points derived from the unique 3D shape of each tooth.

○ Applications

• Orthodontic and prosthetics, especially we will be able to plan of surgical and evaluation of after surgical.

○ Plans

• We will incorporate our proposed method into CBCT's software system.

■ We hope to collaborate with...

• It can be used for CBCT and dental companies (including software companies).

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