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# Supplementary Material

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## Measurement and calculation of PT/PSI

The CT images of patients were saved in DICOM format and imported into SPINEPARA software developed by our engineers. The reconstructed 3D pelvic model and standing anteroposterior radiographs are shown in Figure S1. Four points on the bilateral anterior superior iliac spine (ASIS) and bilateral pubic tubercle were selected to determine the APP, and three points along the anterior median line of the sacrum were selected to determine the midsagittal plane of the pelvis (MSP) (Figure aa). The superior margin of the pubic symphysis was denoted as point D, and the centre of the sacral endplate was denoted as point C. The two fitting spheres could be used to simulate the placement of the acetabular component before THA (Figure ab) and match the maximum diameter of the acetabular component in the coronal, sagittal, and cross-sectional planes after THA (Figure ac). The line connecting the centre of the two spheres served as the rotation axis of the hip joints, with its midpoint denoted as point O (Figure ad). Each pelvic CT model could measure five parameters, including A, B, ∠α, ∠γ, and PI (Figure ae and Figure b). Two parameters, A'p and B' (Figure af), could be measured on the standing anteroposterior pelvic radiographs. Their definitions are shown in Table i.

Pevic tilt (PT) and pelvic sagittal inclination (PSI) were measured before and one week after surgery, respectively, as well as at three, six, and 12 months postoperatively, using a method detailed in our published research. In brief, for the pelvis of a specific individual, ∠α, A, and B are fixed anatomical parameters measured directly from the 3D pelvis model. The ratio of A to B is a fixed value (b = A/B). On standard standing pelvic radiographs, A' is defined as the projected distance of A on the lateral radiographs, and B' is defined as the projected distance of B on the anteroposterior radiographs. Since the line segments of A and B are parallel to the sagittal and coronal planes, A' and B' also satisfy the equation b = A'/B'.

When the APP is perpendicular to the horizontal plane (PSI = 0), parameters such as A', A'p, and ∠α measured from digitally reconstructed lateral radiographs satisfy Equation (1) (Fig ba). In this case, PT equals ∠γ (Figure bb).

$$\cos(\alpha) = A'p/A' \quad (1)$$

$$PT = \angle\gamma \quad (2)$$

When the angle between APP and the vertical line is β (PSI = β), the relationship between A', A'p and ∠α can be expressed by Equation (3), and PT is equal to the sum of ∠γ and ∠β (Figures bc and bd).

$$\cos(\alpha+\beta) = A'p/A' \quad (3)$$

$$PT=\angle\gamma+\angle\beta \quad (4)$$

However, anteroposterior pelvic radiographs can only measure B' and A'p but not A'. Therefore, the fixed equality relation b*B' = A' is used to replace A' in Equation (3). The final formulas for the calculation of PSI and PT are shown in Equations (5) and (6).

$$PSI= \angle\beta = \arccos([A'p*B]/[A*B'])-\angle\alpha \quad (5)$$

$$PT= \angle\beta+\angle\gamma = \arccos([A'p*B]/[A*B'])-\angle\alpha+\angle\gamma \quad (6)$$

**Table i.** Descriptions of spinopelvic parameters.

| Parameter | Description |
|---|---|
| A | The vertical distance from superior margin of pubic symphysis to the line connecting the midpoint of the two spheres represented the bilateral femoral heads or acetabular components. |
| APP | The plane composed of bilateral anterior superior iliac spines and pubic tubercles |
| B | The distance between the midpoint of the two fitting spheres that match the femoral heads or acetabular components. |
| PSI | The angle between the APP and the vertical line. |
| PT | The angle between the line joining the midpoint of the hip axis and the centre of the sacral endplate and the vertical line. |
| PI | The angle between the line connecting the midpoint of the hip axis and the centre of the sacral endplate and the vertical line of the sacral endplate. |
| SS | The angle between a line tangent to the sacral end plate and a horizontal line. |
| $\angle\alpha$ | The angle between the line connecting the midpoint of the line connecting the two fitting spheres and superior margin of pubic symphysis and the APP. |
| $\angle\gamma$ | The angle between the line connecting the midpoint of the line connecting the two fitting spheres and the midpoint of the sacral endplate and APP. |
| B’ | The distance of the line connecting the center of the femoral heads or acetabular components on the pelvic anteroposterior radiographs, which is the line segment corresponding to B. |
| A’ | A line segment corresponding to A, but not measurable on the anteroposterior radiograph of the pelvis. It can only be displayed on the lateral radiograph reconstructed by CT data. |
| A’p | The vertical distance from the superior margin of pubic symphysis to the rotation axis of the hip joints measured on the anteroposterior radiographs, which is actually the projection of A' on the anteroposterior radiographs. |

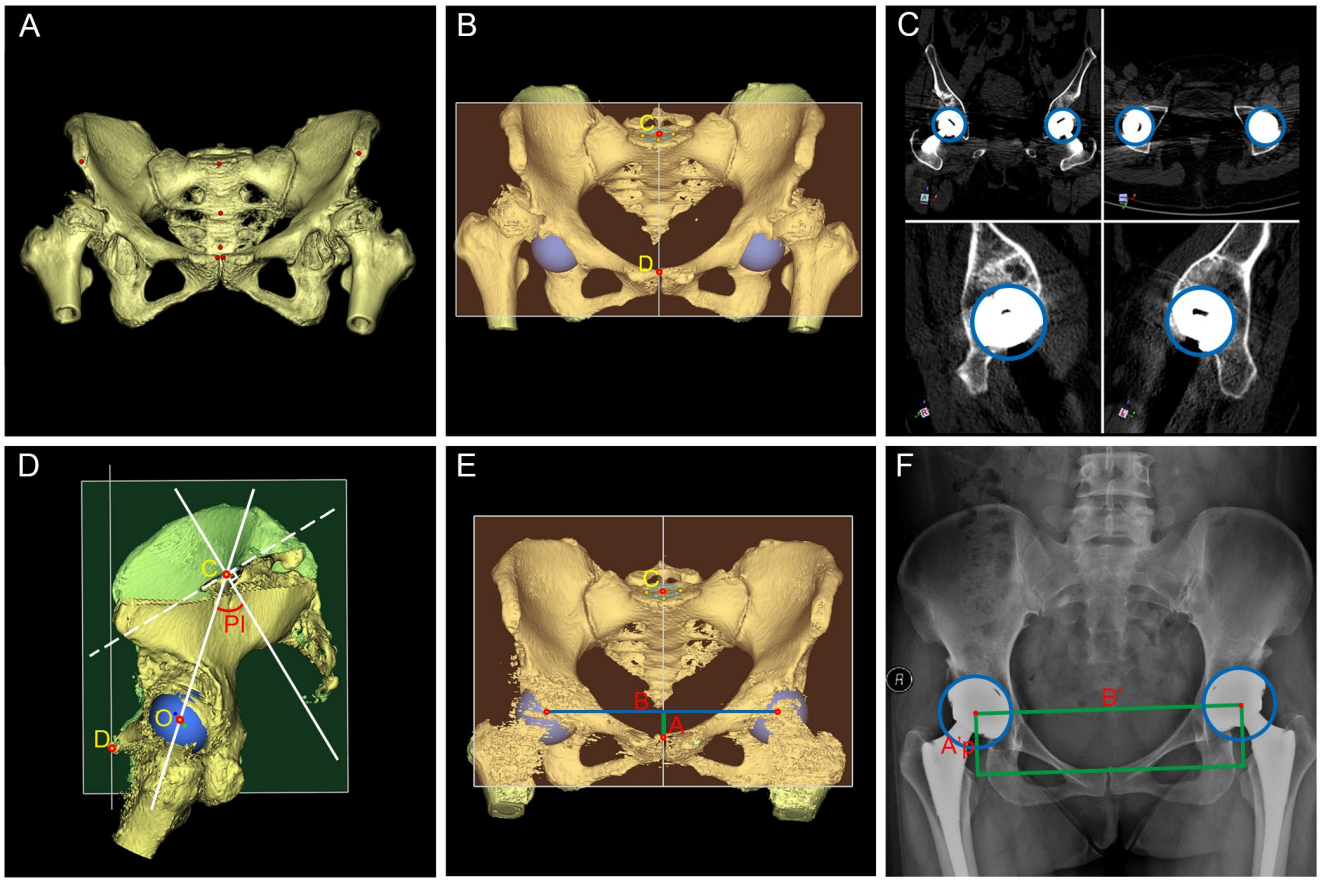


**Fig a.** Reconstruction of the 3D pelvic model and anteroposterior pelvic radiograph. a) Anatomical landmarks were manually selected to determine the anterior pelvic plane (APP) and the mid-sagittal plane (MSP). b) Before total hip arthroplasty (THA), fitting spheres were used to simulate the position of the acetabular component. c) After THA, the fitting spheres were used to fit the maximum transverse diameter of the bilateral acetabular prosthesis in the coronal, sagittal, and transverse planes. d) Sagittal view of the postoperative pelvic model. e) Coronal view of the postoperative pelvic model. f) Postoperative anteroposterior pelvic radiograph.

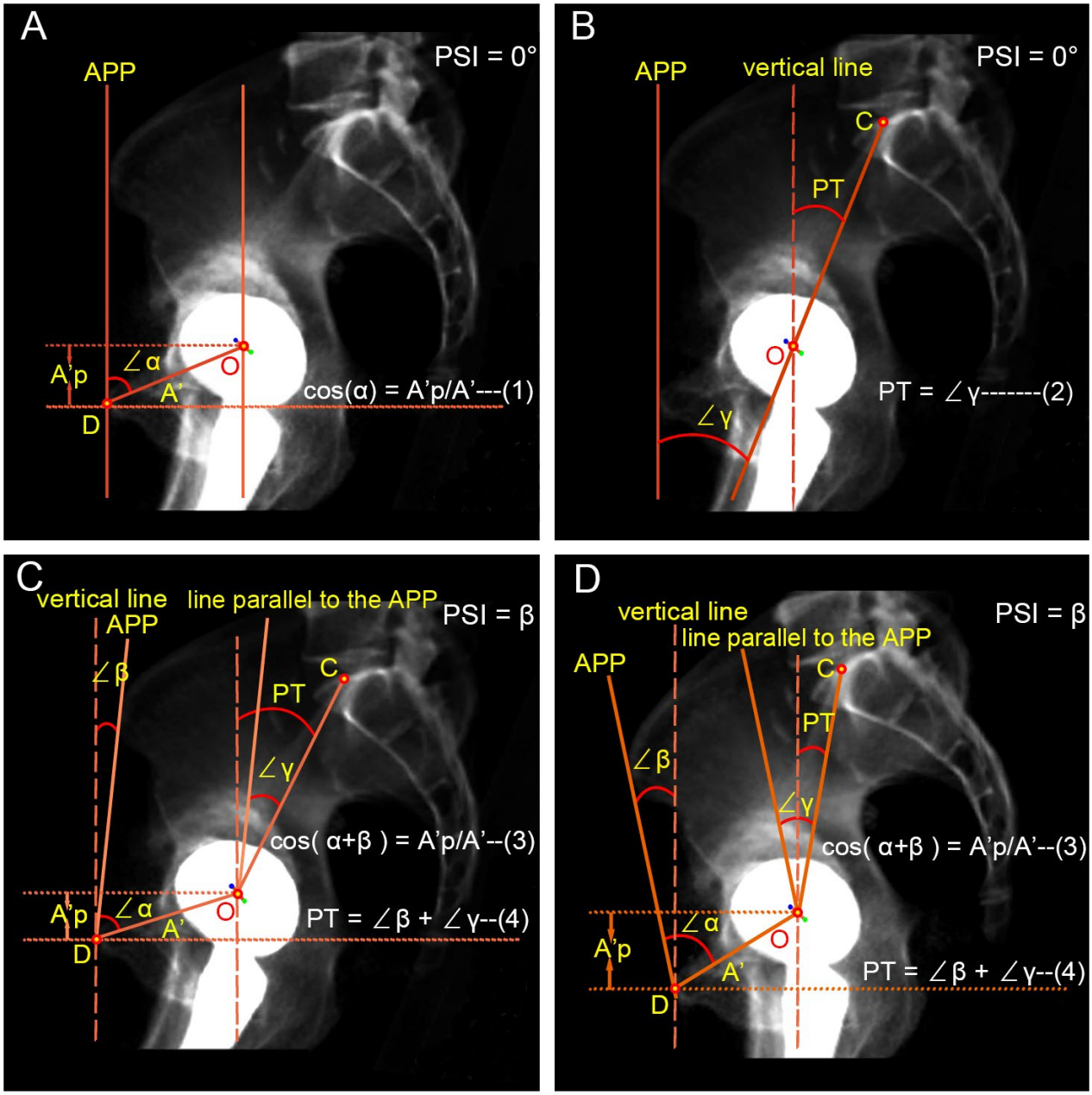


**Fig b.** a) A′, A′p, and ∠α measured from the digitally reconstructed lateral radiograph have an inverse cosine function relationship. b) When the anterior pelvic plane (APP) is parallel to the vertical line, ∠γ is equal to pelvic tilt (PT). c) When the pelvic posterior tilt, the superior margin of pubic symphysis (D) moves upward, and the projection distance A'P of the distance (A') between point D and hip joint rotation center (O) on the anteroposterior radiograph decreases, so the A'p/A' value also decreases. Through the inverse cosine function table, it can be seen that the smaller the A'p/A', the smaller the value of cos (α + β), the greater the value of α + β, so the β at this time is positive. d) When the pelvic anterior tilt, A'p becomes larger, so the A'p/A' value also becomes larger. The greater the cos (α + β) value, the smaller the value of α + β, so β is negative.