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Biomechanical interaction between mother and fetus during vaginal delivery

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The second stage of labor is widely associated with childbirth trauma. The impact of the fetal position on women and neonates is considerable, with high rates of birth trauma associated with occipito-posterior (OP) positions [1]. The main goal of this study was to analyze the influence of a persistent OP malposition when the sacrococcygeal joint movement is allowed and the fetal head is deformable.

A finite element model was used to simulate vaginal delivery in the vertex presentation. The mother's model includes the pelvic floor muscles (PFM), hip bones, sacrum, coccyx, and pelvic ligaments. The fetus is composed of the skin, skull, brain, sutures, and fontanelles. Simulations were performed in Abaqus® software to mimic the second stage of labor with the fetus in the occipito-anterior (OA) and OP positions. Specific diameters of the fetal head were measured to calculate the molding index. The stretch and maximum principal stresses on the PFM were evaluated, as well as the coccyx rotation.

The maximum principal stresses were measured at different paths of the PFM. The main difference between the two positions was a 55.20% increase from the OA to the OP position in the stresses measured. The coccyx rotation in the OA and OP positions was, respectively, 0.98º and 2.17º. Concerning the fetal head, a molding index of 1.87 was obtained in the OA position, compared to 1.81 in the OP position.

The results obtained indicate that the muscles are subjected to higher stresses in the OP position. Therefore, this position is more demanding for the PFM than the OA position, corroborated by previous numerical and clinical studies. Nevertheless, at the OP position, the molding index is lower than the one calculated for the OA position. Since fewer molding indicates a lower reduction in the diameters, the head circumference will be greater, and, consequently, the chance of injury to the PFM increases. Thus, a more favorable scenario for the fetus could be harmful to the mother.

REFERENCES

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