The Biomechanics of Breastfeeding: Bridging the Gap between Engineering-Based Studies and Clinical Practice

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Understanding how a baby extracts milk from the breast is the vital cornerstone to practicing sound, effective breastfeeding management in order to optimize milk transfer from mother to baby. In turn, this allows one to maximize the transfer of calorie-rich nutrients, predominantly of breast milk fat.

For several centuries, received wisdom was that babies extract milk from the breast by a combination of baseline suction, compression, and relaxation of the baby’s jaws against the breast, and rhythmical waves of pressure applied to the underside of the breast/nipple held within the baby’s mouth by the tongue [1]. Based on this premise, the core principles of WHO/UNICEF training were established, focusing on optimizing the positioning and attachment of the baby at the breast in order to maximize the effectiveness of milk transfer.

In the past decade, however, this received wisdom has been challenged both by the use of modern ultrasound equipment [2, 3] and engineering-based modeling of breast anatomy (specifically the milk duct system) and the baby’s sucking action [4, 5].

A key novel claim was that the baby can generate localized, added suction with its tongue to enhance milk transfer [2, 6]; this has since been confirmed [7], although the evidence is that this novel mechanism remains secondary to the core process of peristaltic expression by the tongue.

In contrast, engineering-based studies [4, 5] have proven both controversial and contradictory, providing new insights yet posing fresh challenges. To date, however, they have not altered the core underpinnings of best breastfeeding practice and management.

In the field of medicine, it is recognized that the validity of randomized controlled trials should be evaluated by a set of quality control...
standards, and the framework of critical appraisal skills is a way of achieving this. No such quality standards or guidelines exist for evaluating engineering-based models of a physiological process. A comparable framework is needed if the validity of engineering-based models is to be effectively assessed. In practice, in order to address the veracity of the conclusions drawn, it is essential to be able to evaluate several of the assumptions made in these models: whether or not they are valid, and whether specific elements are missing from current models which might affect their outcome.

Certain physical assumptions, made during the modeling process, are known to be incorrect, but have been made in order to simplify the modeling process – for example, that the milk duct walls are rigid. Further ways in which the modeling process departs from known physiology include: (i) the view that negative suction pressure is the primary force in these models, without any contribution being made by the progressive peristaltic pressure exerted by the baby’s tongue [8], and (ii) the core assumption that the milk duct system remains patent throughout a feed, thereby ignoring the occlusive impact of the baby’s jaw closure with each suck. The inclusion of any of these natural processes would radically alter the conclusions from modeling, thereby disproving the claim that suction alone can explain milk extraction [4] while giving greater credence to the suggestion that suction alone may not fully explain milk extraction [5].

One feature consistently missing from such analyses is the clinical implications arising from them, and what they add to our understanding in terms of how to help mothers and babies breastfeed more effectively. To this end, a pivotal role played by peristaltic tongue movements, essential to effective breastfeeding, will be identified and elaborated, so providing evidence as to why the core management principles of positioning and attachment are so central to breastfeeding success.

References
