I-Host laboratory

Research unit name: NeuroDiderot Unit (UMR1141), inDEV team
Research unit address: Robert-Debré Hospital, 48 boulevard Sérurier. 75019 Paris
Internship location: The internship will take place in NeuroSpin neuroimaging center (CEA Saclay, 91) where the inDEV team is partly located: CEA/SAC/NeuroSpin/UNIACT Bât 145, PC 156 91191 Gif-sur-Yvette

II - Host institution

Name: Inserm
Headquarters address: INSERM Paris-IDF Centre-Nord. 86 rue Regnault. 75013 Paris

III - Host team

UMR or institute: NeuroDiderot unit UMR1141
Team name: inDEV team (Imaging neurodevelopmental phenotypes)
Team leader: Dubois Jessica
Team address: CEA/SAC/NeuroSpin/UNIACT Bat 145, PC156 91191 Gif-sur-Yvette
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IV – Internship subject

Title: Early sensorimotor development in preterm infants: a study of the brain central sulcus anatomy in relation to locomotor training and behavioral outcome

The development of the human brain is a highly complex process that begins in utero and continues rapidly after birth. Early infancy is a particularly dynamic period, characterised by rapid cortical folding and the emergence of functional brain networks driven by key cellular mechanisms (Kostović et al., 2019). The sensorimotor system is among the first to mature, allowing infants to integrate early sensorimotor experiences. Within this system, the central sulcus constitutes the anatomical boundary between the primary motor and somatosensory cortices, and is one of the earliest cortical folds to appear (~18th week of gestation, Chi et al., 1977). Its morphology is closely linked to the topographic organisation of motor and sensory functions, known as the homunculus of Penfield, which is thought to be present even at the preterm stage (Dall'Orso et al., 2018). Some of its anatomical features then serve as markers of body-related function (Germann et al., 2020), in particular the "hand knob" that is identifiable already in preterm infants (de Vareilles et al., 2022). Studying the early morphology of the central sulcus may therefore provide valuable information on emerging motor abilities.

Our team has previously shown that the most pronounced morphological changes in typically developing infants between 1 and 3 months of age occur in the medial regions of the central sulcus, including the hand knob, likely reflecting the maturation of upper-limb and face representations which may develop more intensely between these ages (Dornier et al., 2025). Building on these findings, the present internship aims to improve the early identification of atypical neurodevelopmental patterns of the central sulcus in high-risk populations, such as very preterm infants (born before 32 weeks of gestational age). Specifically, we aim to investigate whether the evolution of the sulcus morphology between term-equivalent age (TEA) and two months of corrected age (2m CA) is associated with sensorimotor outcomes. A secondary objective is to evaluate the potential impact of early interventions on this evolution. In particular, we will examine the effects of a locomotor training intervention on a "CrawliSkate," a mini skateboard adapted for newborns that supports prone positioning and early motor exploration. This intervention has previously shown benefits on sensorimotor behaviour in preterm infants (Dumuids-Vernet et al., 2023). Here, we aim to determine whether it also influences brain development, particularly the anatomical development of the CS, and whether it may help reduce developmental delays.

Data collection for this project has already been completed at Robert-Debré Hospital. The study is part of a longitudinal protocol investigating early development in very preterm infants, with 3T-MRI and EEG acquisitions at TEA and 2m CA. 66 infants were included at TEA. Part of them were allocated to a daily Crawliskate training group (~10 minutes per day for 8 weeks). Longitudinal MRI data at TEA and 2m CA were successfully collected for 34 infants (trained infants: n=16). As a follow-up of preterm-born children, neurodevelopmental evaluations of sensorimotor, language and cognitive abilities were carried out using standardized scales at around 2 years of age (Brunet-Lézine révisé: n=7; Bayley scales: n=18) and 3.5 years (Bayley scales: n≥16, ongoing data collection).

This internship will focus on the analysis of longitudinal MRI data of preterm infants, with a focus on the early morphology of the central sulcus, in relation to locomotor training and neurodevelopmental outcome during childhood. It will take place at NeuroSpin (Saclay, 91). In addition to data analyses, participation to ongoing experiments will be possible (neurodevelopmental evaluations of 3.5-year children at Robert-Debré hospital; MRI data collection of infants at NeuroSpin for another project).

References

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