

22. DEEP LEARNING DRIVEN ASSESSMENT OF INFLAMMATORY REGIONS IN DIGITIZED KIDNEY BIOPSIES

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Introduction: Nephritis produces injury by disrupting the renal structure with inflammatory cell proliferation. Pathologists visually estimate and compartmentalize nephritis into glomerular or interstitial regions. Computational approaches can assist with a more detailed characterization of this manifestation.

Methods: We developed a deep learning framework to classify nephritis on digitized renal biopsies. A patch-based deep neural network (pDNN) model was constructed using whole slide images obtained from chronic kidney disease patients admitted to Boston Medical Center (n=96). The pathologist-driven categorization of nephritis was used as the output label to train the pDNN model. Grad-CAM based visualization was then used to automatically identify regions of predicted cell proliferation. Performance of the models was evaluated using a subset of data that was not used for training and the regions of interest identified by the visualization method were confirmed by a team of pathologists.

Results: The pDNN model accurately predicted the type of nephritis on test data (Accuracy: 82%; Sensitivity: 83%; Precision: 85%). The visualization technique showed high correspondence with pathologist annotated regions of hypercellularity. Our results indicate that deep learning frameworks have the capability to emulate the expert pathologist classification and can segment the regions of cell proliferation which in turn provides a rationale by which the overall prediction is inferred on the type of nephritis.

Conclusions: Deep learning can provide a rational framework for accurate assessment of nephritis and may assist clinicopathologic diagnosis by identifying regions of cell proliferation.



18. TRANSLATION OF POLICY INTO CLINICAL PRACTICE: THE IMPACT OF CHAMPS ON MATERNAL CHILD HEALTH AND RACIAL DISPARITIES IN MISSISSIPPI HOSPITALS

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Introduction: Low breastfeeding rates, which predominantly affect underserved and minority populations in the US, are a risk factor for poor infant health. The WHO Baby-Friendly Hospital Initiative (BFHI) offers a set of guidelines (the Ten Steps to Successful Breastfeeding) that aim to increase breastfeeding rates and improve maternal child health practice. The Center for Health Equity, Education, and Research (CHEER) created the Communities and Hospitals Advancing Maternity Practices (CHAMPS) program to help hospitals translate the Ten Steps guidance into policy, with the goal of gaining Baby-Friendly designation. In 2014, CHAMPS launched in Mississippi, which had no Baby-Friendly hospitals and the lowest breastfeeding rates in the US.

Hypothesis: We hypothesized that implementation of the Ten Steps in Mississippi would translate into increased breastfeeding initiation and exclusivity rates, and decreased racial disparities.

Methods: From 2014-2019 Mississippi hospitals enrolled into CHAMPS, which provided intensive support and training to help implement the Ten Steps. We tracked and analyzed monthly aggregate hospital data stratified by race on breastfeeding, skin-to-skin care, and rooming-in practices. Changes were analyzed by t-tests using SPSS.

Results: All 39 hospitals that enrolled into CHAMPS worked on implementation of the Ten Steps, and 22 gained Baby-Friendly designation, from zero designated hospitals at baseline; this accounted for >50% of Mississippi births. Breastfeeding initiation in CHAMPS hospitals increased from 56% to 66% ($p < .05$) and exclusivity from 26% to 37% ($p < .05$). The disparity between Black and White dyads decreased by 17%. Skin-to-skin and rooming-in rates increased significantly for all dyads. Skin-to-skin increased from 31% to 91% ($p < .01$) after vaginal birth and from 20% to 86% ($p < .01$) after cesarean birth. Rooming-in increased from 19% to 86% ($p < .01$).

Conclusions: Translation of the Ten Steps into policy and practice significantly increased breastfeeding initiation and exclusivity, and decreased racial disparities in breastfeeding rates in Mississippi. We proposed a novel approach to include family history, as is often available from medical charts, and showed improved power to detect genetic association with rare variants in large cohorts or biobanks.



24. MECHANICAL TEMPORAL SUMMATION IS ASSOCIATED WITH GREATER MUSCLE CO-CONTRACTION DURING WALKING IN KNEE OSTEOARTHRITIS

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Introduction: People with knee osteoarthritis (OA) walk with excessive muscular co-contraction known to worsen the disease. Central pain sensitization seen in chronic pain could be associated with muscle activation during walking.

Objective: The purpose of this study was to investigate the association of pain sensitization with knee muscle co-contraction during walking in people with knee OA.

Methods: In participants with symptomatic knee OA, central sensitization was assessed as mechanical temporal summation (TS) at the patella of the painful knee. TS was considered present if there was an increase in pain rating during or after a train of 10 mechanical stimuli applied via Von Frey monofilaments compared with pain rating after a single stimulus. Vastus lateralis (VL) and medialis (VM), lateral hamstrings (LH) and gastrocnemius (LG), and medial hamstrings (MH) and gastrocnemius (MG) muscle activity was recorded using surface electromyography (EMG) while walking at self-selected and fast paces. Muscle co-contraction index (CCI) was calculated using published methods for medial and lateral muscle pairs during pre-activation, loading response, and midstance phases of gait. Independent sample t-tests were used to compare CCIs between people with and without mechanical TS.

Results: Of 42 participants in this study, 57% had mechanical TS at the affected knee. Compared to those without TS, during pre-activation, people with TS had 41.3% and 39.3% greater VL-LH CCI at a self-selected pace fast pace, respectively, as well as 41.9% greater VM-MH CCI at a fast pace. During loading response, TS group showed 64.2% and 73.1% greater VM-MH CCI at self-selected pace and fast pace, respectively. TS group had 80.3% greater VL-LG CCI during midstance at a self-selected pace.

Conclusions: Central sensitization may be associated with altered motor function during daily activities like walking. These results indicate that strategies to reduce pain sensitization may also assist with normalization of motor patterns in people with knee OA.



4. QUANTIFICATION OF CORNEAL COLLAGEN CROSS-LINKING IN KERATOCONUS WITH INVERSE SPECTROSCOPIC OPTICAL COHERENCE TOMOGRAPHY

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Introduction: Optimization of corneal collagen cross-linking (CXL) is hindered by the inability to immediately measure treatment effects. Inverse spectroscopic optical coherence tomography (IS-OCT) is an emerging technique capable of non-invasively detecting nanoscale ultrastructural changes. The IS-OCT output measure *D* was previously found to increase with increased collagen cross-linking in vitro. We performed a pilot study to measure changes in keratoconus patient eyes before and after CXL by IS-OCT in vivo.

Methods: With IRB approval, keratoconus patients scheduled to undergo CXL were consented and enrolled. Standard epi-off CXL was performed in one eye (Glaukos, San Clemente, CA). Immediately preceding, and one month after unilateral CXL, both central corneas were imaged with dual channel visible and near-infrared light OCT. *D* was calculated and compared between eyes. A two-tailed paired Students t-test was used for statistical analysis.

Results: The change in corneal *D* before and after CXL was $+1.78 \pm 0.36$ ($n = 3$), compared to -0.22 ± 0.34 ($n = 3$) in the contra-lateral non-CXL cornea ($p = 0.03$). Delta *D* in the anterior half of the cornea was $+1.83 \pm 0.12$ in CXL eyes vs. -0.21 ± 0.68 in non-CXL eyes ($p=0.047$). Delta *D* in the posterior half of the cornea was $+1.68 \pm 0.47$ in CXL eyes vs. -0.19 ± 0.37 in non-CXL eyes ($p=0.03$). The increase in *D* after CXL appeared more consistently higher in the anterior corneal stroma and diminished in the posterior-most region.

Conclusions: In this preliminary study, we found that IS-OCT can be used to image corneas quickly and non-invasively in patients. *D* was increased in corneas following CXL. IS-OCT could help quantitate CXL *in vivo*, but further study with additional patients and methods for improved data normalization are needed to validate these preliminary results.

