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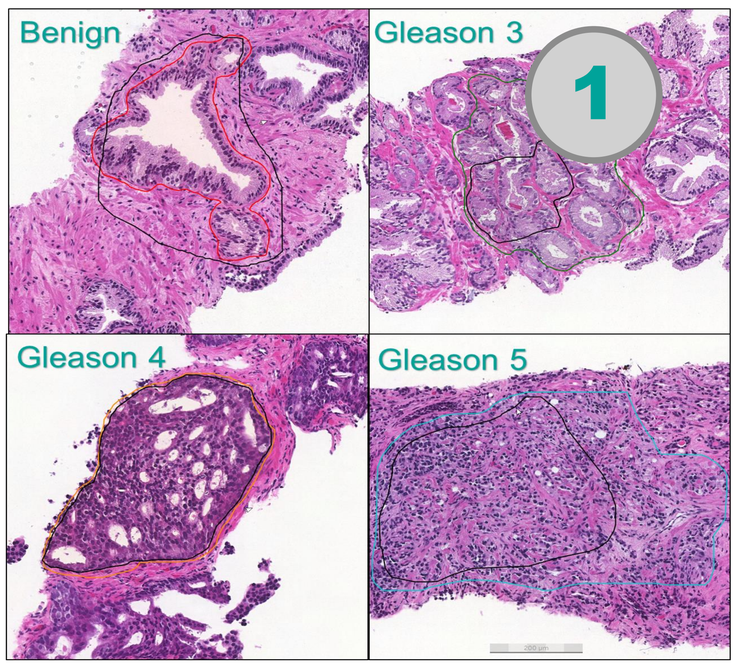
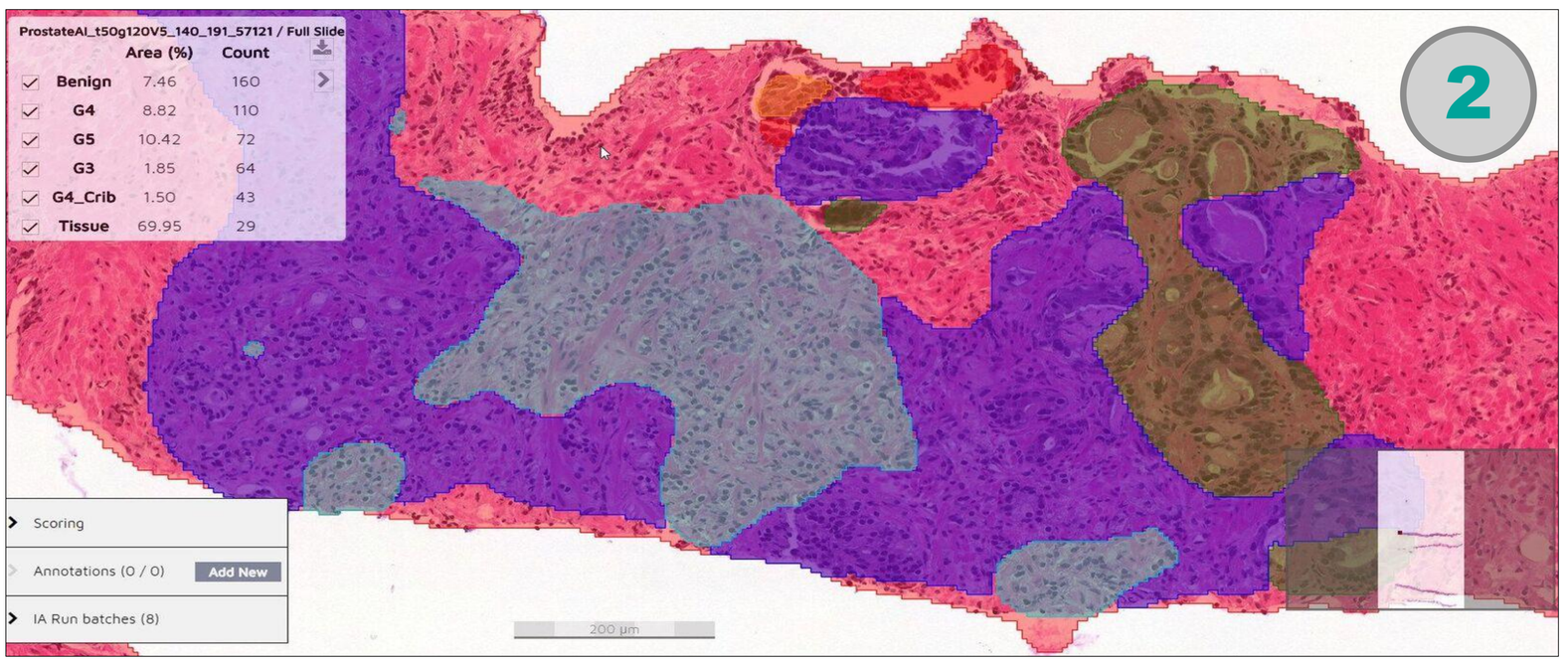
Deep-learning neural network in prostate cancer detection and grading



1. Examples of different histological classes for training of the AI algorithm



2. Example of AI classification results per biopsy core

BACKGROUND

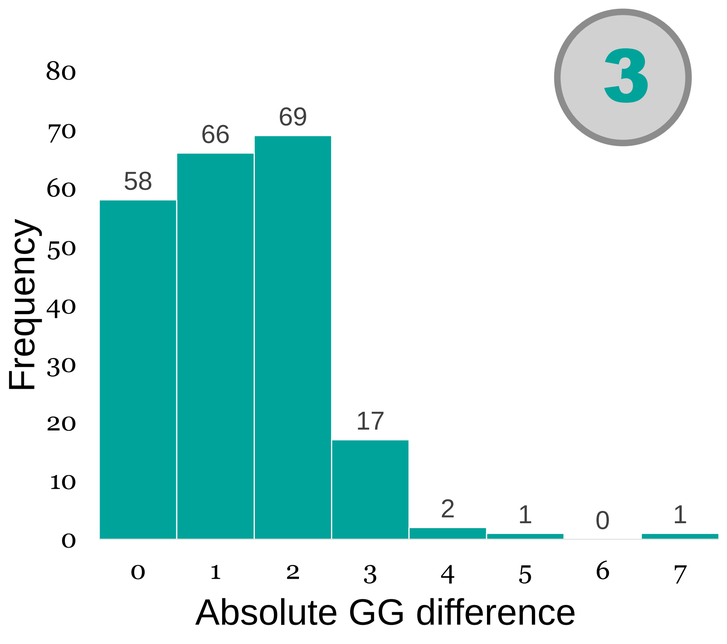
Prostate cancer (PC) is globally the second most common cancer and fifth most frequent cause of mortality in men (1). The pathological Gleason grade grouping (GG), which is based on the glandular architecture applied on prostate biopsies, is considered the most accurate diagnostic and predictive tool for patient outcome (2-3). By artificial intelligence (AI), the diagnostic work-up is expected to become less subjective and faster compared to the current, fairly labour-intensive manner. Automated GG diminishes interobserver variation (4).

METHODS

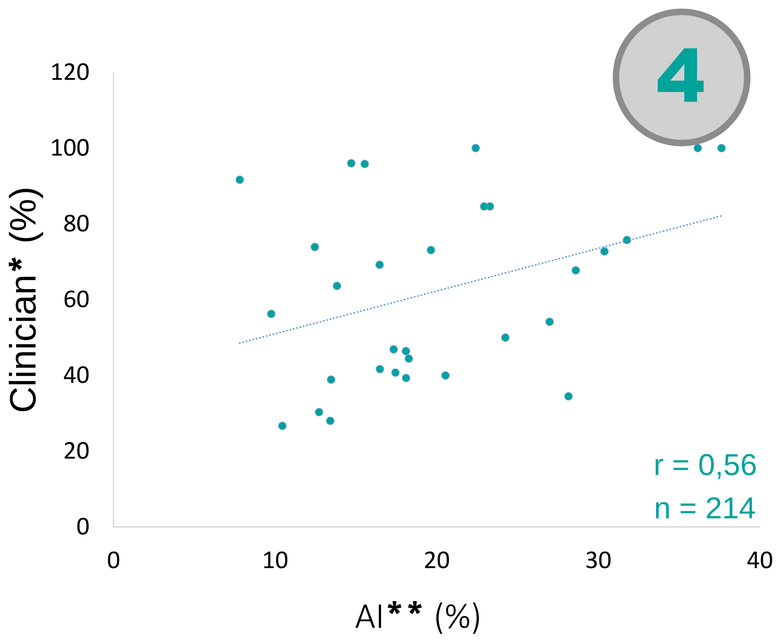
To train a deep neural network for the detection and grading of PC, an uropathological expert team annotated 59 scanned prostate biopsies with 0.26µm/pixel resolution. Glandular areas were annotated into benign, Gleason 3, Gleason 4, cribriform Gleason 4 and Gleason 5. For an independent validation of agreement between AI and a pathologist, 214 biopsies were analysed using a 7-tier grouping: benign (0), GG1 – 5, and three subgroups in GG 5 (Gleason 4+5, 5+4, 5+5).

RESULTS

From the training areas, AI assigned benign, G3, G4, cribriform G4 and G5 with a total area error of 12.33, 1.25, 0.99, 0.80 and 0.14 %, respectively. In the independent analysis of 214 biopsies, there was total agreement between AI and clinician in 58 cases. AI gave a higher GG in 134 cases, and clinician in 22 cases compared with AI.



3. Absolute Grade Group (GG) difference between AI and clinician in a test set of 214 prostate biopsies



4. Pearson correlation for total tumour area between AI and clinician (p<0,0001)
***: Tumor length/total biopsy length (%)**
****: Tumor area/total biopsy area (%)**

CONCLUSION

The currently applied AI algorithm is feasible for detecting and grading PC. AI may have direct implications in clinical diagnostics of PC in the future by reducing clinical workload. Similar approaches may be applicable for other malignancies as well.

References: **1**. Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer. 2015 Mar 1; 136(5):E359–86. **2**. Gleason DF. Classification of prostatic carcinomas. Cancer Chemother Rep. 1966 Mar ;50(3):125–8. **3**. Epstein JI, Egevad L, Amin MB, Delahunt B, Srigley JR, Humphrey PA, et al. The 2014 International Society of Urological Pathology (ISUP) Consensus Conference on Gleason Grading of Prostatic Carcinoma: Definition of Grading Patterns and Proposal for a New Grading System. Am J Surg Pathol. 2016 Feb;40(2):244–52. **4**. Nakai Y, Tanaka N, Shimada K, et al. Review by urological pathologists improves the accuracy of Gleason grading by general pathologists Urological oncology. BMC Urol. 2015;15:1–7.

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