Artificial Intelligence Based Improvement of Pulmonary Frozen Section WSI's, a Pilot Study

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BACKGROUND

Frozen section examination is one of the key consultation to surgeons for decision making during surgical procedures especially oncological surgeries. Besides its speed, some artifacts and quality issues such as ice freezing, shattering, overstaining, blurring due to imbalanced thickness may occur.

In this study, we investigated effect of a self-regularized GAN based Frozen-to-FFPE algorithm by a prospective reader study.

METHOD

In this study we included 30 frozen and 30 ffpe sections from 30 lung adenocarcinoma and squamous cell carcinoma patients collected from 2 different institutions. All samples scanned with Leica Aperio AT2 WSI scanner and de-identified before transformation and reader studies. With AI-Generated WSIs, 90 WSIs included to reader study.

The Generative Adversarial Network (GAN) based algorithm consists of a generator and a discriminator parts. To preserve nuclear and fine details, a self-regularization and spatialattention mechanism also developed.

12 pathologists from two different institutions attended to reader study. 30 questions were asked to participants with corresponding Whole-Slide images on a web-based WSI viewer and questionnaire software named ViraTest, developed by Virasoft Corporation.

The questionnaire consisted of the diagnosis, the image quality, presence of artifacts for single image questions, and the change in quality and artifacts for double-side-view image questions (FS, and AI-FS side by side). The time spent in each question was also recorded.
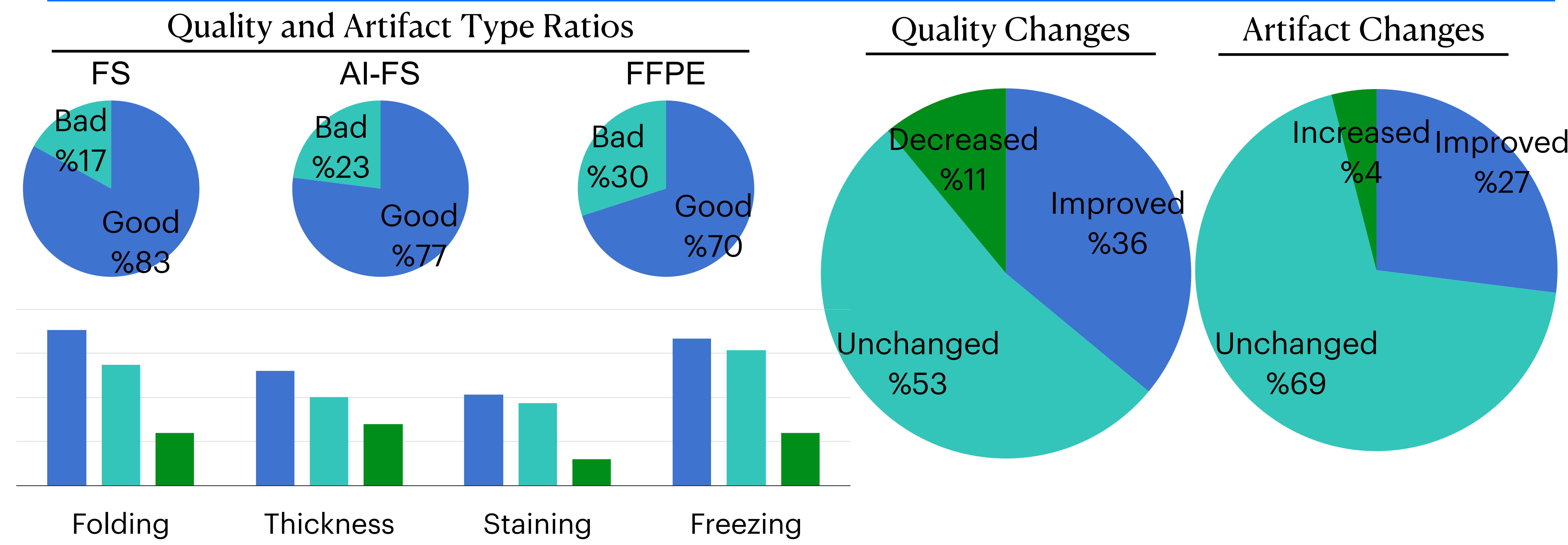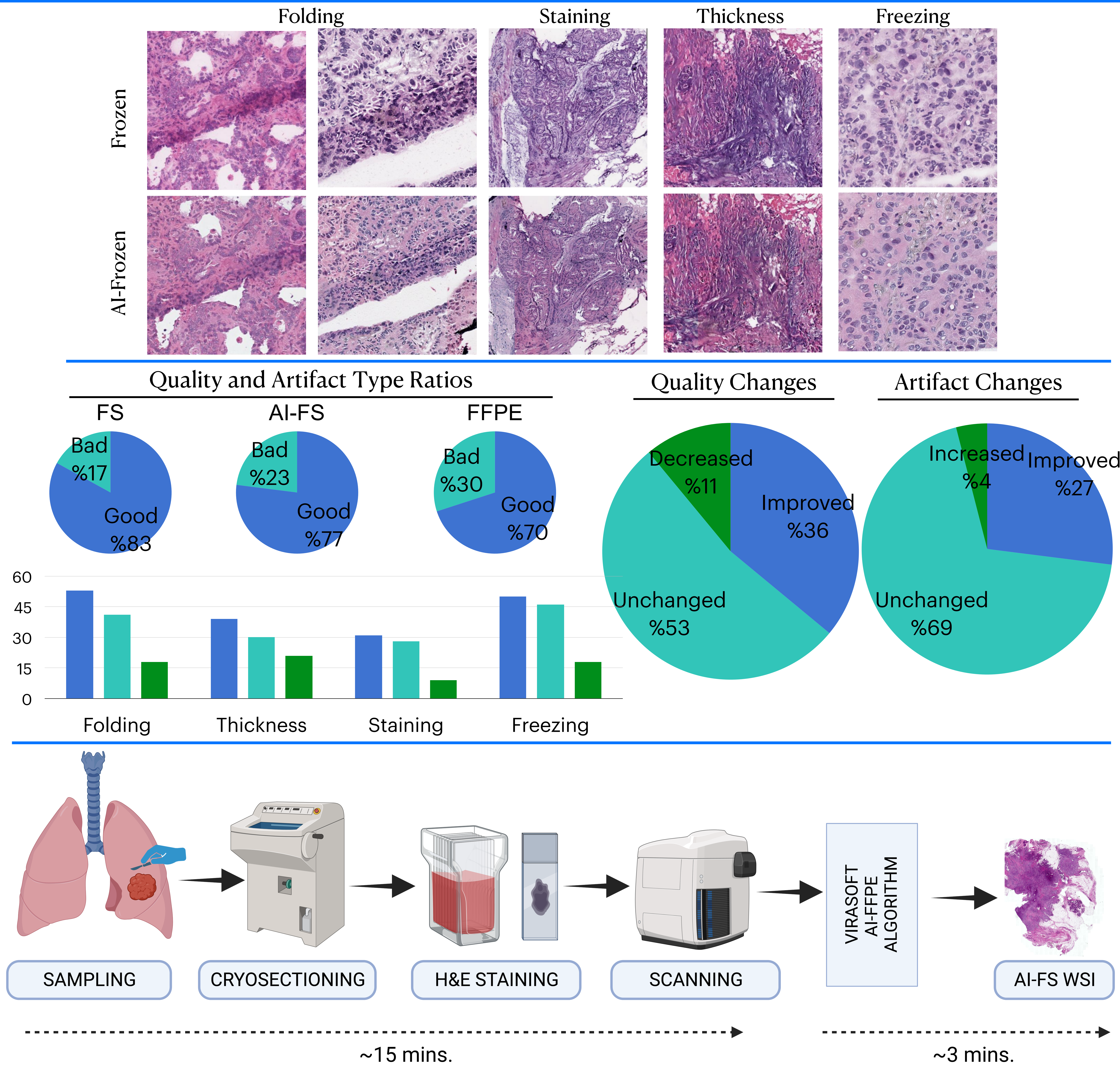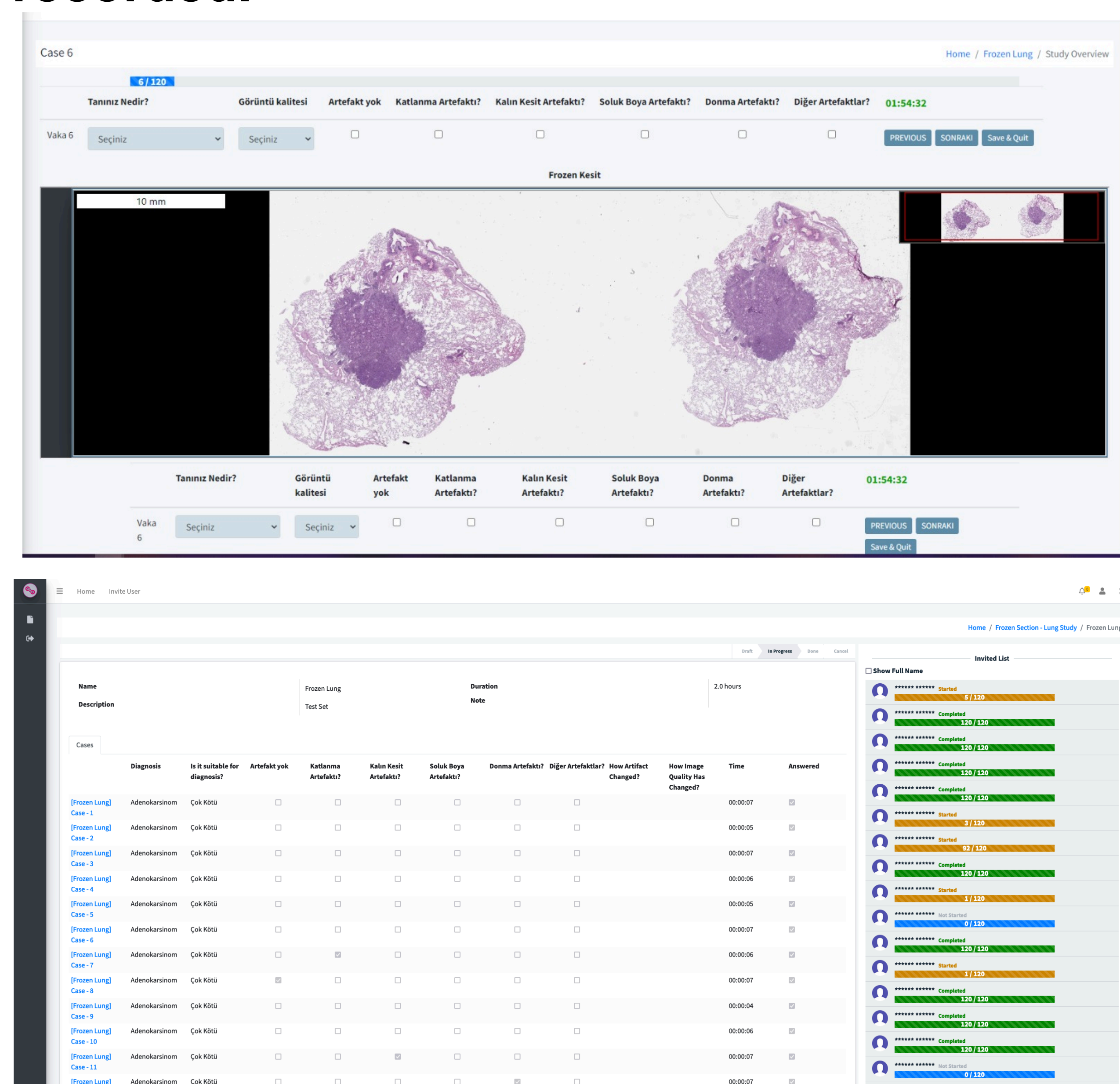
RESULTS

The image quality was measured on a 1 to 5 scale, from worst to best image quality. The percent of above average image quality (good and best) for FS, and AI-FS were 17% and 23% (p=0.005).

The percentage of WSI's with folding artifacts were 53%, 41%, and 18% for FS, AI-FS, and FFPE, respectively (FS vs AI-FS, p=0.001). The percentage of WSI's with thickness artifacts were 39%, 30% and 21% for FS,AI-FS, and FFPE (FS vs AI-FS, p=0.25). The percentage of WSI's with staining defects were 31%, 28%, and 9% for FS,AI-FS, and FFPE (FS vs AI-FS, p=0.25). Freezing artifacts were seen in 50%, 46%, and 18% of FS, AI-FS, and FFPE WSI's (FS vs AI-FS, p=0.29).

Side by side evaluation of FS and AI-FS revealed that the image quality was improved in 36%, unchanged in 53%, and decreased in 11% in AI-FS, whereas artifacts were improved in 27%, unchanged in 69%, and increased in 4%, respectively.

	FS (%)	AI-FS (%)	FFPE (%)
Above Average Quality	17	23	70
Folding Artifacts	53	41	18
Thickness Artifacts	39	30	21
Stain Defects	31	28	9
Freezing Artifacts	50	46	18
Other Artifacts	31	23	8

CONCLUSION

Virasoft AI-FFPE algorithm increased image quality, decreased some of the artifacts of frozen section in lung cancer WSI's. Overall quality of FS WSI's were improved with the algorithm. In the further studies, our team will investigate effect of the algoritm on data from different scanners and tissues to understand generalizability of the algorithm.

REFERENCE

A deep-learning model for transforming the style of tissue images from cryosectioned to formalin-fixed and paraffin-embedded. Ozyoruk KB, Can S, Darbaz B, Başak K, Demir D, Gokceler GI, Serin G, Hacisalihoglu UP, Kurtuluş E, Lu MY, Chen TY, Williamson DFK, Yılmaz F, Mahmood F, Turan M. **Nature Biomedical Engineering** 6: 1407–1419, **2022**