

AI-based reading of breast tomosynthesis images: the experience of a dedicated private women's imaging center in Athens, Greece.

Situated in Athens, Greece, the Delta Digital Imaging Center is a privately-owned clinic which has a well-established reputation in the field of breast imaging. Recently the center has acquired the iCAD ProFound AI system — an artificial intelligence-based software platform for the reading of digital breast tomosynthesis images. We wanted to know more about the Delta Digital Imaging Center in general and their experience with the ProFound AI system in particular, so we spoke to chief radiologists Dr. Nikolas Dimitropoulos, Medical Director of the Center, and Dr. Mariana Ioannidou, CEO.



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Q *Before we get down to details, please give us some general background regarding the Delta Digital Imaging Center.*

Yes, let's start with a bit of the history of our center, the Delta Digital Imaging Center. Together with a group of doctors, all of whom were specialized in women's imaging, we set up the center in 2007. All of our colleagues have 20 years' experience in private and public health services not just in Greece but also throughout Western Europe. We chose the title of "Delta Digital" for our center because at the time of the founding of our center, digital technology was *the* pioneering technological development in breast imaging.

The center is situated in a very pleasant location in the center of Athens next to several large university hospitals, with whom we have a very close and mutually fruitful relationship.

We pride ourselves on the fact that right from the beginning, we set the mission of our center to be the provision of medical services at the highest quality and technological level, while at the same time always being aware of, and reactive to, each woman's particular personality, psychology and sensitivities, especially since, almost by definition when our patients come to us, they are often going through a stressful time.

Our center operates as an exclusively private institution, so we don't have any contracts with insurance organizations. Since there is no national centralized, mammographic screening system in Greece, our patients come for routine examination based on their personalized needs (after self-referral on their own initiative or on medical advice/referral). The majority of women we see are dealt

with on an outpatient basis, but we do have some in-patients, mostly for interventional reasons such as breast biopsies or for pre-surgical breast lesion localization. Each year, we see approximately 9,000-10,000 patients for breast-related issues and examinations, both diagnostic/symptomatic and screening. Although breast cases represent the majority of the women we see, we also carry out other interventions and examinations in the wider field of women's health, such as transvaginal ultrasound, abdominal ultrasound and bone densitometry. Of the patients we see, 70% come from the city of Athens itself, the rest from the surrounding provinces and the Greek islands.



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Q *Now let's focus on the center's breast imaging activities*

Overall, we are well equipped to deal with the patients we see — we have a digital mammography system, a digital breast tomosynthesis (DBT) system and several ultrasound systems, fitted with 3-D probes and with breast elastography capabilities, as well as a bone densitometry system. For any patients who may need additional imaging modalities such as MRI or CESM these are carried out in the nearby university hospitals and diagnostic centers, with whom, as

we said, we have a very close and regular collaboration.

We carry out about 50-60 breast interventional procedures per month such as pre-surgical localizations, by mammography or ultrasound of impalpable breast lesions as well as ultrasound-guided biopsies.

As for stereotactically guided breast biopsies for microcalcifications and also MRI-guided biopsies and lesion localizations by MRI, we refer these patients to our colleagues in the appropriate specialized departments of the hospitals and diagnostic centers with whom we collaborate. The overall clinical management and surgery of our patients are carried out by these large university and private sector hospitals which have specialized breast units and clinics. These patients then come back to us for postsurgical evaluation so that approximately 10-15 percent of all our patients are actually being examined as part of post-surgical follow-up program.

Q *What is the typical work-up for breast patients in your center?*

The typical management of our patients is relatively standard with the underlying principle being to be able to communicate the results of the examination back to the referring physician as quickly as possible. Of course, the process starts by the patient coming to the center for their pre-arranged appointment. The programmed exam is then carried out, as well as any supplementary exams that may be needed. At this stage the patient waits in the lounge while the report is being prepared, which typically takes 15 - 20 minutes, after which the patient is called back into the doctors' office, so that her situation can be explained to her. She receives the report with any specific recommendations and appointments for an appropriate follow-up, depending on the diagnosis and the estimated personalized risk of developing breast cancer.

In low risk patients, a digital mammography is usually performed as the first line examination, supplemented by ultrasound if the patient has dense breasts. If for such patients prior mammograms are available, then DBT is carried out. For example, if suspicious lesions have been detected on mammography, DBT is carried out usually followed by ultrasound. In women with increased risk, or in women with basic risk but with very dense breasts, DBT is performed from the outset. When we do carry out DBT, we always use 2D synthetic views and when we investigate clinical or mammographic abnormalities, we perform both 2D views and tomosynthesis views. The total time for the tomosynthesis exam, including the actual exam itself and the reading, lasts about 30-40 minutes, of which 20 minutes is needed for the reading and preparation of the report. We find our patients have a positive opinion of tomosynthesis as they understand the superiority of 3D over 2D imaging. They all have been informed of the fact that there is little or no excess radiation involved in the 3D tomosynthesis system we use, compared to 2D.

Of course, it is well known that the reading and evaluation processes in tomosynthesis are time-consuming and tiring for the radiologist. This is even more burdensome since, to be absolutely sure that we didn't miss any suspicious lesions, we operate

a double reader system for every tomosynthesis exam, which of course adds to the time and the effort involved.

Q *Since when have you had the iCAD ProFound AI software?*

The installation of the iCAD ProFound AI System took place four months ago and even in that relatively short period of time, we have been able to appreciate the advantages and reassurance that the system gives us for our tomosynthesis cases. With the new system, we now only have one radiologist reading the tomosynthesis images, in parallel with the ProFound AI System. Taking the information provided by the AI system into account, which is analyzed by the algorithm in under two minutes and available at the workstation immediately, the radiologist evaluates the images and composes the report. The final reports are now available for the patients in 10 minutes..

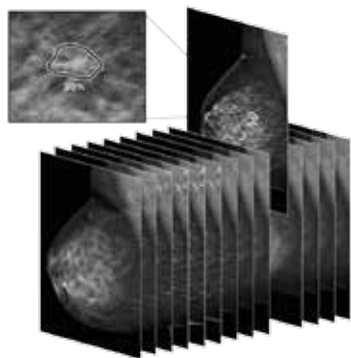
This is not our first time with CAD — about 15 years ago, we had some previous experience with earlier CAD systems in 2D mammography, but overall that experience was not satisfactory because the level of false positive results was too high. However, since then we have had close scientific collaboration with the Department of Informatics and Medical Imaging at the University of Athens, who convinced us that the application of modern deep-learning technology could provide much more powerful and accurate algorithms and could indeed bring about a revolutionary change in the methods of studying and reporting medical imaging exams. Thus, we were open to the idea of investigating and eventually accepting new, reliable applications.

ProFound AI offered the solution we were looking for as it really shortens the reading time, frees up the second reader, and offers us the assurance that even when our radiologists are tired or overworked by handling too many exams, they can be assisted in finding cancers, even small lesions.

The operation of the ProFound AI system is simple and intuitive so there is virtually no learning curve regarding the



A view of the waiting lounge in the Delta Digital Imaging Center. The use of ProFound AI system shortens the reading time of breast tomosynthesis images so that patients typically have to wait for no more than 20 minutes in the lounge before receiving their report.



The ProFound AI system is a high-performing, concurrent-read, cancer detection and workflow solution that rapidly analyzes each tomosynthesis image accurately, detecting both malignant soft tissue densities and calcifications with high accuracy.

operation of the system. Moreover, the longer a radiologist uses ProFound AI, the more he or she becomes confident in the algorithm's capabilities. The radiologist has to gain experience of the functioning of the system in different types of cases and evaluate his or her results along with the analysis provided by the software.

Before using the system in routine, we carried out a validation process involving known cases in order to be sure of not missing any cancers. We have chosen to operate the system in high sensitivity mode, in order to be absolutely sure not to miss any lesions, although some of these detected lesions have turned out to be sonographically benign. In routine practice, ProFound AI works rapidly and enables the routine case workflow to be accelerated.

We have found that the system is of special help in the characterization of very small breast nodules that sometimes can be missed or characterized wrongly as benign (e.g. lymph nodes). The ProFound AI system is also helpful in identifying small architectural distortions and in the evaluation of small areas with microcalcifications.

We have by now already studied a total of about 500 of both previous and new cases; we now use ProFound AI in every tomosynthesis exam that we carry out. Of course, individual radiologists can initially have varying degrees of skepticism regarding the system and so, for such radiologists a longer time may be needed for validation and for confidence to be built. But we are sure that the routine use of the system will convince

even the most skeptical of radiologists and widen the future horizons.

Q *Clinically what advantages does the system bring you?*

That's easy to answer. On the basis of the experience we have acquired so far, we can say that the incorporation of ProFound AI into our work-flow has enabled us to:

- Reduce false negatives (fewer cancers missed)
- Reduce false positives (fewer additional exams and negative biopsies)
- Improve overall patient management
- Free up more time for interventional procedures and discussion of reports and appropriate future management with patients
- Have quick and accurate tomosynthesis exam results for patients waiting in the lounge
- Identify interesting cases for educational and scientific use
- Be at the cutting edge of technology
- Offer a better service to our patients
- Have a new, useful (and experienced) partner in our center

Q *So you are content with the new AI system?*

Well as you can judge from the previous comments, we are indeed positively excited by the application of ProFound AI

Our satisfaction with the current system has spurred us on to actively assess the usefulness of ProFound AI in 2D mammography and in the evaluation of breast density.

As for other possible future developments, it would be useful if the AI systems could enable us to correlate lesions and images with prior 2D or 3D exams. In addition, worldwide multicenter studies and international meetings of experts in the field would also be useful to continue to study the capabilities of ProFound AI in screening and diagnosis.

Q *How do you see the future? Any thoughts on extending the use of tomosynthesis to screening?*

It is well established that breast tomosynthesis is a more sensitive modality than 2D mammography for screening. However, for the time being at least the

use of tomosynthesis is not practical because the reading of the images is very time-consuming, a problem that is exacerbated by the current lack of radiologists experienced in the field.

Both these drawbacks can be overcome by use of the ProFound AI technology in that reading time can be significantly reduced (by more than 50%) and in our opinion, the need for a second reader can be avoided, as the system is more sensitive than the average experienced radiologist in identifying small lesions.

Thus tomosynthesis-based screening could be envisaged if all the tomosynthesis systems were equipped with AI.

Q *What are your thoughts on AI in radiology in general? Opportunity or a threat?*

We are convinced that the next generation of imaging systems — not just mammography — will have to have AI technology built-in. The new generation of radiologists will simply have to become familiar with these new technologies and how to use them in routine workflow. The advantages AI offers for radiologists is increased confidence in the diagnosis and decreased time and effort.

The everyday collaboration of radiologists and AI-based systems will result in an on-going educational process that will increase the ability level of every radiologist. Thus, we are convinced that AI is a great opportunity, especially for the younger radiologists. In contrast to the opinion held by some commentators that AI-based systems are only suitable for a small percentage of experienced radiology users in large hospitals and centers with lots of cases, we believe that AI is for everybody, it can be especially helpful for younger, less experienced radiologists practicing on their own or for small centers where there are only very few radiologists available.

Another area where we believe that AI-based applications have a role to play is as an educational tool. Indeed, we plan to incorporate this aspect in the continuing educational processes and workshops that are run by the Hellenic Society of Breast Radiologists. This is an organization in which we are major instructors, founding and council members (Dr. N. Dimitropoulos - President, Dr. M. Ioannidou - Member).