

ABSTRACT

Restoring and managing oral health requires a combination of visual, tactical, hand skills, and kinesthetic experiences based on three-dimensional structures. In the Autumn of 2019, the College of Dentistry started incorporating computer-aided design (CAD) files accessible in any setting through tablets, smartphones and laptops, offering a user-friendly on-demand experience for students. The Covid-19 breakout created a major challenge for maintaining the students’ academic progress due to the limited face-to-face interaction and restriction on handling analog samples required in the preclinical laboratories. Using an already developed platform, the CAD library was expanded to different courses, such as Dental Anatomy, allowing prompt return of the courses online, and later in the hybrid mode. A Qualtrics survey conducted had an excellent (64%) response rate, and the student feedback was overwhelmingly positive. Additionally, student performance on practical exams in courses where CAD files were implemented showed improved results from previous years (p= 0.05) despite limited hands-on instruction. In conclusion, the CAD files were well accepted, utilized, and beneficial, and will continue to be implemented moving forward.

INTRODUCTION

The COVID-19 pandemic posed a new challenge in learning material that typically requires hands-on experience for DDS candidates. More specifically, a need was identified in the first-year Dental Anatomy course to create a way for students to learn tooth morphology virtually. Using extracted teeth and a CAD/CAM software,, a digital tooth library was created for students to study from anywhere.

Figure 1



MATERIALS & METHODS

- Over 100 extracted human teeth were selected and scanned using a benchtop 3D scanner
- Scanned tooth files were enhanced using a CAD-CAM software and then exported.
- A digital tooth identification library was created and distributed to dental and dental hygiene students
- Files were used by students to self-study tooth morphology and for Zoom review sessions for class practical exams
- Qualtrics survey was distributed at the end of the semester to collect student feedback

Figure 2

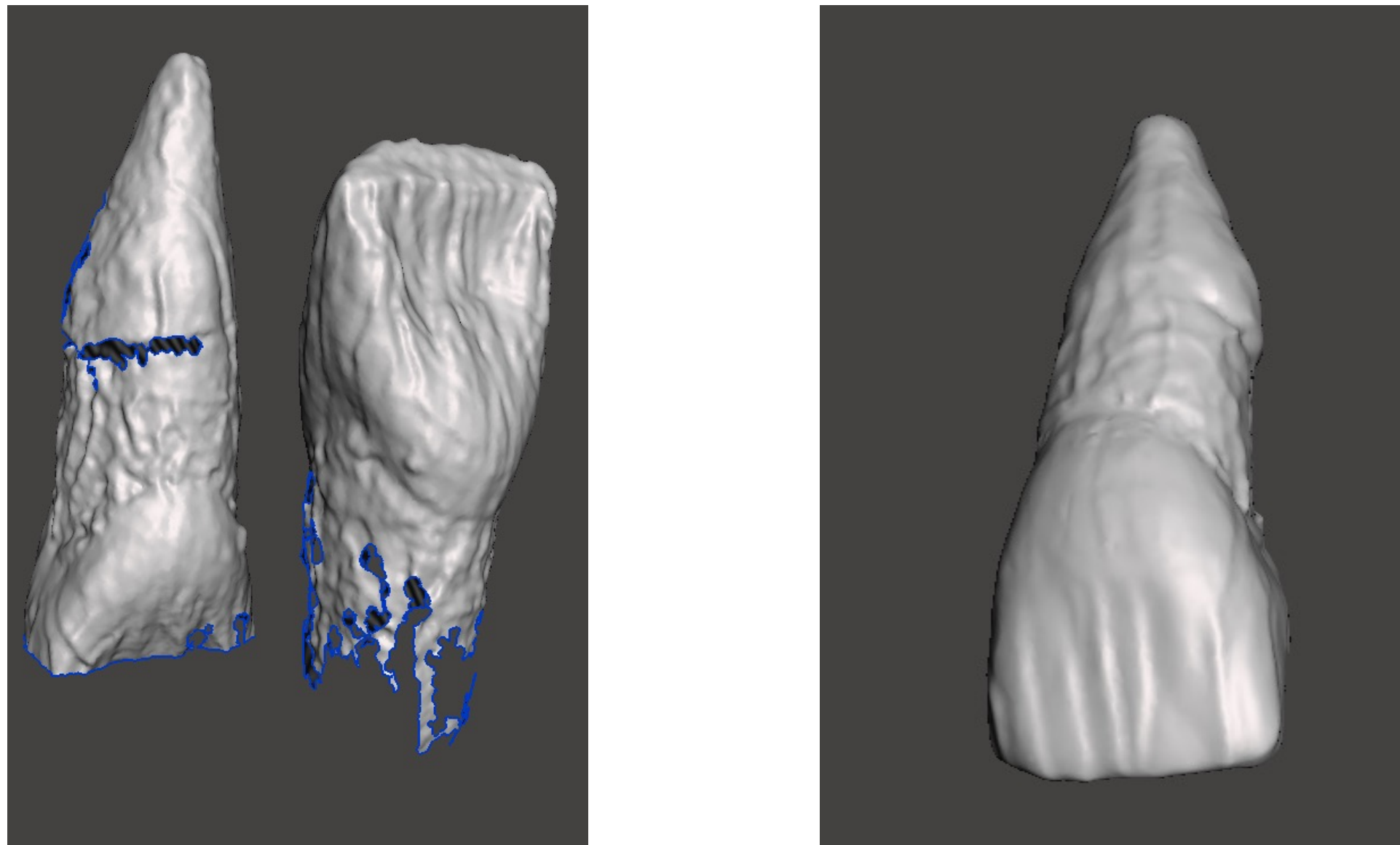


Figure 2. Coronal and apical halves of teeth were scanned and imported into Meshmixer. The files were then aligned, merged, reduced, and smoothed, to create the final product that was exported as a .ply file.

Figure 3

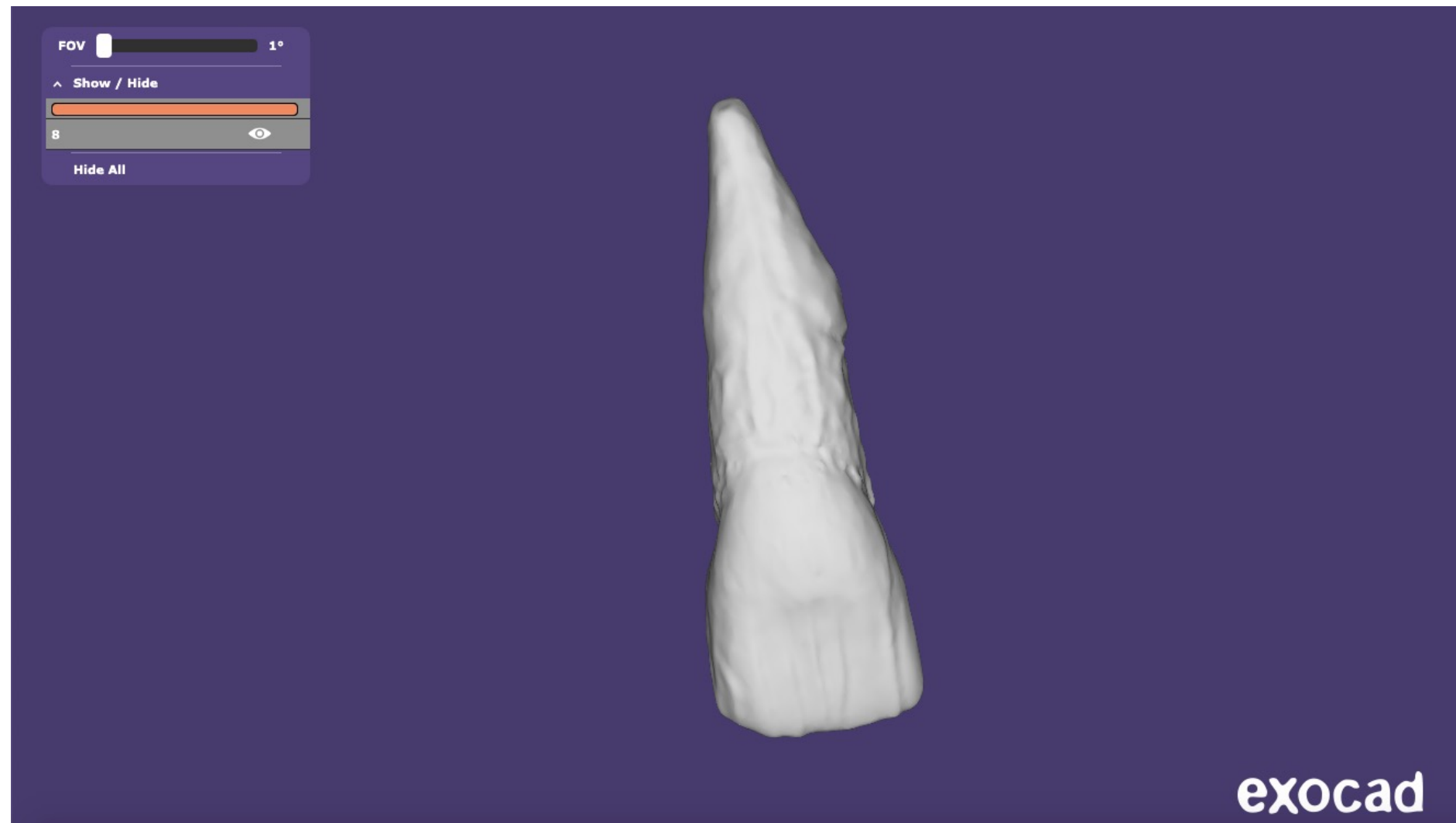
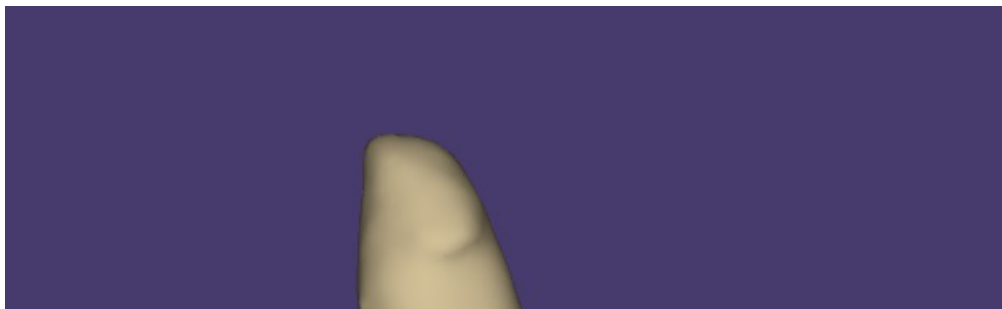


Figure 3. An example of one of the final files being viewed in exocad, an app/website students used to view the tooth ID files on phones, tablets and computers

Figure 4



RESULTS

- Despite the 50% decrease in hands-on in-person learning, the class of 2020 averaged 19.1/20 on the Tooth Identification Practical, as compared to 18.8/20 for the class in 2019.
- 72 students in 2020 had a perfect score and 105 received an 'A' compared to the 59 students with a perfect score and 98 who received an 'A' in 2019
- 91% of students found the digital files easy to use and used them outside of class time to study
- 87% of students felt the Zoom review sessions helped them prepare for course practical exams
- 95% of students felt the digital files had a positive impact on final course grades
- 93% of students would like to see digital files available in future preclinical courses

Table 1

# of Students (2019)	Score (out of 20)	# of Students (2020)	Score (out of 20)
59	20	72	20
25	19	26	19
14	18	7	18
11	17	8	17
7	16	3	16
2	15	2	15
1	13	1	14
1	7	1	10
Average	18.8	Average	19.15

Table 1. Comparison between the grades for the Tooth Morpholgy Practical scores from the fall of 2019 and the fall 0f 2020. In both years, 120 DDS candidates took the practical exam.

Table 2

	Strongly Agree (%)	Agree (%)	Somewhat Agree (%)	Neither Agree or Disagree (%)	Somewhat Disagree (%)	Disagree (%)	Strongly Disagree (%)
I found the digital files easy to use	42.86	32.86	15.71	1.43	2.86	1.43	1.86
I used the tooth ID files outside of lab to support my academic progress	72.58	19.35	0.00	3.23	0.00	0.00	4.84
The Zoom Review Sessions helped me prepare for the practicals	61.29	20.97	4.84	9.68	0.00	1.61	1.61

DISCUSSION

During the Fall of 2020, the biggest fear for faculty and DDS candidates was that education and training was going to suffer due to in-person learning being decreased by 50%. Dental Anatomy is one of the most important classes for a first-year dental student because this is when they learn the language of dentistry and the morphology of the dentition. It builds the foundation for every other class in the dental curriculum.

Due to the intricacy and detail of learning tooth morphology, hands-on learning in the lab and handling extracted teeth is imperative to learning the material. The digital tooth morphology files not only supplemented for the typical pre-pandemic learning, but they also improved student outcomes. Even with lab time decreased by 50% compared to the fall of 2019, the DDS candidates taking the dental anatomy course in fall of 2020 had a higher class average, a higher number of students receiving “A’s”, and a lower number of students failing (p=0.05). Although this was not statistically significant, this suggests that this digital tooth morphology library is an effective study tool and can supplement in-person learning without detriment to the student.

The digital tooth morphology files were not only an effective study supplement, they were also widely accepted by faculty and students, and they helped simulate real-life practical exams.

CONCLUSION

The digital tooth morphology library was a well-utilized and effective learning tool for first-year DDS candidates. Students found it easy to use, beneficial in studying, and would like to see development of a digital curriculum for other preclinical courses.

Since the fall of 2020, more enhancements have been made to the digital tooth morphology library and they are still used by the course director and students to enhance learning. Other courses in the dental curriculum have also adopted this idea and have started incorporating a digital component for students.

Continued development of a digital curriculum will not only enhance the student experience at The Ohio State University College of Dentistry, but has the potential to