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The Effect of Digital Three-Dimensional Reality Models on Patient Counseling for Renal Masses

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ABSTRACT

Background and Objectives: Patient counseling for treatment of renal masses is complex. It can be difficult for patients to understand their disease and make treatment decisions when being shown standard black-and-white, two-dimensional computed tomography scans or magnetic resonance images. In a telehealth setting, the patient-physician interaction can be even more challenging. We sought to determine the impact of using digital three-dimensional (3D) models during consultation visits for patients with renal masses.

Methods: Forty-seven patients participating in a consultation visit for renal masses, both in-person and virtual, were shown a digital 3D model comprised of their kidney, renal mass, and key adjacent structures as part of their counseling. Patients then completed a five-question survey to assess the impact of the 3D model on their visit, with a sixth question administered to telehealth patients.

Results: Thirty-five patients undergoing telehealth visits and 12 patients seen in-person were shown the digital 3D model and surveyed. Survey results were universally positive, with all Likert scores > 4.7 (1 – 5 scale). There were no differences between the telehealth and in-person groups. Patients noted the digital 3D model made telehealth visits as effective as in-person visits (average Likert score 4.94).

Conclusion: Counseling for patients with renal masses can be augmented with patient-specific digital 3D models, leading to increased provider loyalty, lower levels of patient anxiety, and better understanding and shared decision making.

Key Words: Carcinoma, Patient counseling, Renal cell, Shared decision-making, Virtual reality.

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INTRODUCTION

While the overall incidence of cancers has decreased over the past few decades, the incidence of kidney cancer continues to rise.[1] Small renal masses compose most of this growth, and the incidence of stage I disease has increased from 3.7 to 7.0 per 100,000 US adults in the past decade.[2,3] The availability of multiple treatment options, such as ablative therapy, surgical intervention, and active surveillance can make counseling patients with stage I kidney cancer a difficult challenge.[4–6] Treatment choice can further be complicated by the relatively similar cancer control efficacy demonstrated among treatment options.[7,8] Even among surgical options, there are varying pathways such as radical and partial nephrectomy, with patient-specific advantages and disadvantages for each approach.[9,10]

With myriad treatment options having similar oncologic and functional outcomes, the American Urologic Association has defined these treatment decisions as "preference sensitive," and recommended shared decision making be employed during the patient consultation visit.[11] Additionally, shared decision is now endorsed by numerous academic and professional societies to optimize decisional quality.[12–14] Effective shared decision making starts with a clear patient understanding of their disease. Prior studies have shown that patient understanding of their disease during the initial consultation visit is lacking, and this may be due to the lack of a straightforward means to explain the patient's treatment options.[15]

The COVID-19 pandemic changed the traditional patient-physician interaction by necessitating these consultation visits be performed virtually in many instances. Even as restrictions regarding in-person visits have lifted, virtual

visits have remained popular. Traditionally telehealth visits included routine health maintenance visits, follow-up visits for low-risk conditions, and postoperative visits where minimal information was exchanged. However, the hurdles to effective telemedicine scale exponentially as the complexity of care increases. This especially holds true in new diagnosis visits for cancer patients. The physician must communicate the location and type of the cancer, approach to treatment, and post-treatment prognosis in a comprehensible and precise manner, while simultaneously curating a robust patient-physician relationship. Accomplishing this through the use of traditional computed tomography (CT) scans and magnetic resonance (MR) images becomes even harder, as the surgeon is now challenged with displaying – and then explaining – the complex imaging over remote telehealth platforms.

Previous studies have examined the impact of three-dimensional (3D) models on surgical planning for patients with kidney cancer. While 3D printed models have been previously used for patient counseling, these are difficult to use for virtual visits.[16] In addition, these models also lack the details and ease of use that is critical to effective counseling for many types of oncologic cases. For example, the size and location of the mass within the kidney is an important consideration in planning renal mass resections, and this can be difficult to fully visualize using physical models. In this context, we identified patients scheduled for a counseling visit, either in-person or telehealth, for renal mass treatment. These patients were counseled by a single surgeon, and a digital 3D model was used to augment the visit as a patient education tool. We sought to determine the effect of the digital 3D digital model on patient decision making by administering and analyzing a post-visit patient survey.

METHODOLOGY

A prospective, single arm cohort was composed of patients undergoing consultation for renal mass treatment. At each visit, treatment plans were discussed with the digital 3D model as an additional tool for patient counseling. After the consultation visit, the patient was asked to take a survey regarding the use of the 3D model. If the patient agreed, a five-question paper survey was administered to assess the impact of the model on decision making during the visit. If the visit was virtual, a sixth question was added to assess how the model impacted the telehealth visit. The survey was designed using components of the shared decision making and decisional conflict scales, as well as net promoter score. Questions were scored on a 1 – 5 Likert scale. This study was exempt from institutional review board oversight.

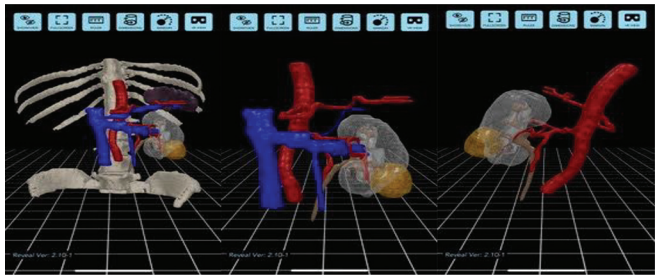

Figure 1. Three-dimensional imaging.

Prior to the consultation visit, digital 3D digital models were created from CT or MR imaging scans by a medical software company (Ceevra, Inc.) and the models returned to the surgeon via mobile device within two business days of being requested. These models included the kidney, mass(es), collecting system, ureter, artery (or arteries), vein(s), and ribs. In some cases, the models included other structures such as renal cysts and spleen (**Figure 1**). During in-person consultation visits, the models were viewed using the surgeon's mobile device. If the visit was conducted virtually, the models were viewed on the telehealth screen as part of the visit.

As an analytic step, we tabulated survey scores for each encounter and calculated averages and range. We compared surveys for telehealth patients to those who had traditional, in-person visits. Finally, we compiled patient feedback from the free text survey field and organized the data into themes.

RESULTS

A total of 47 patients were consecutively surveyed by a single surgeon at Advent Health Celebration Hospital from February 1, 2020 through November 30, 2020. Thirty-five patients had their consultation via videoconference, largely due to the COVID-19 pandemic. Twelve patients presented in person for their consultation visit.

Survey scores were universally positive, with all average Likert scores > 4.7 (**Table 1**). Specific scores included improved understanding of their disease (average Likert score 4.98), improved understanding of treatment options including risks and benefits (average Likert score 4.91), impact on the decision regarding choice of physician (average Likert score 4.98), and decreased anxiety regarding condition (average Likert score 4.72). When the models

Table 1.
Patient Consultation Survey Scores and Average Response Scores (1 – 5 Likert Scale)

Survey Question	Average Likert Score (SD)
Question 1: The 3D model helped me understand the nature and details of my condition.	4.98 (0.14)
Question 2: The 3D model helped me understand the treatment option that my physician is recommending, including its risks and benefits.	4.91 (0.28)
Question 3: The 3D model helped reduce my concern or anxiety about my condition or treatment.	4.72 (0.49)
Question 4: The 3D model has or likely will influence my decision regarding choice of treatment.	4.89 (0.31)
Question 5: The 3D model has or likely will influence my decision regarding choice of physician.	4.98 (0.14)
Question 6 (telehealth only): Having a 3D model as part of my telehealth consultation made it as effective as an in-person consultation.	4.94 (0.31)

Abbreviations: SD, standard deviation; 3D, three dimensional.

were used for telehealth visits, patients felt strongly that the model made the telehealth visit as effective as an in-person visit (average Likert score 4.94). Additionally, there were no differences in average survey scores between telehealth and in person visits ($P > .05$, **Table 2**).

Patients provided 27 comments on the digital 3D models. Two of the comments were illegible and one of the patients noted they preferred in-person visits. The remaining 24 comments were organized into themes (**Table 3**). Five themes were noted: better understanding of disease (9 responses), more comfortable/confident in treatment (3 responses), better visualization of disease (4 responses), technology-related (3 responses), and other (5 responses).

DISCUSSION

Care for patients with renal masses has evolved rapidly, and many reasonable treatment or surveillance choices now exist for patients with this disease.[17] However, the way counseling is provided for these patients remains the same, despite advancements in other areas of treatment, and in other nonmedical areas of technology. This has created an opportunity for innovative solutions to the longstanding issues with patient-physician communication for complex disease states. In this context, our study has several significant findings.

Patients reported improved understanding of their disease after viewing the digital 3D model with their physician. When improving patient disease-specific knowledge using decision aids, patients are more likely to actively engage in shared decision making with their provider, adhere to treatment plans, and less likely to experience decisional conflict.[18,19] This is notable, as there are few ways to communicate details about renal masses outside of imaging, which to patients can be opaque and difficult to understand. It is likely that the digital 3D model, an easy to understand, visual representation of the disease, allowed a deeper and more comprehensive picture for patients selecting treatment.

Patients additionally reported that the 3D digital model improved their understanding of treatment options including risks and benefits and influenced their treatment decision (average Likert score 4.89). This is important to

Table 2.
Patient Consultation Survey Scores and Average Response Scores (1 – 5 Likert Scale) Comparing In-person and Telehealth Visits

Survey Question	In-Person (N = 12)	Telehealth (N = 35)	*P*
Question 1: The 3D model helped me understand the nature and details of my condition.	5.00 (0)	4.97 (0.17)	0.55
Question 2: The 3D model helped me understand the treatment option that my physician is recommending, including its risks and benefits.	4.92 (0.29)	4.91 (0.28)	0.92
Question 3: The 3D model helped reduce my concern or anxiety about my condition or treatment.	4.62 (0.49)	4.74 (0.51)	0.68
Question 4: The 3D model has or likely will influence my decision regarding choice of treatment.	4.92 (0.29)	4.89 (0.32)	0.78
Question 5: The 3D model has or likely will influence my decision regarding choice of physician.	4.92 (0.29)	5.00 (0)	0.1

Abbreviation: 3D, three-dimensional.

Table 3.
Survey Responses and Themes

Response Theme	Survey Response
Better understanding of disease	"I understand my cancer better."
	"Helped to understand my choices"
	"I better understand what is seen in my kidney."
	"Much clearer understanding of the tumor."
	"Thanks for sharing. Easier to understand, especially after my first experience."
	"Helps my understanding"
	"Very helpful"
	"Thanks for explaining better to me."
	"As a family, we appreciate you reviewing this with us to understand the cancer."
More comfortable/confident in treatment	"I feel much more comfortable."
	"I'm more confident"
	"Ready to proceed it made decision easier"
Better visualization of disease	"Easier to visualize."
	"I really liked learning about my condition via the 3D model."
	"I'm glad I could see my cancer."
	"Appreciate the new view."
Technology-related	"Love the technology"
	"Great look, like it."
	"All imaging should be this way."
Other	"Neat"
	"Thank you for the information"
	"Interesting"
	"Very up to date information."
	"Interesting"

note, as patients who are more passive in the decision making process have decreased adherence to therapies.[18] Additionally, patients with increased decision conflict are 59 times more likely to change their mind, 23 times more likely to delay their decision, and five times more likely to regret their decision.[20] These patients are significantly more likely to blame their doctor for poor outcomes.[21] Decision aids such as the digital 3D model decrease decisional conflict and may represent a remedy for patients making decisions in this setting.[22]

Patients reported that the physician's use of the digital 3D model influenced their decision regarding choice of physician. High levels of patient satisfaction with physician have been linked to hospital accreditation and reimbursement rates as well as reduced incidence of malpractice grievances.[23] The increase in physician satisfaction among patients in this setting is an area of significant potential growth among healthcare systems adopting clinical decision aids. Additionally, patient anxiety, often associated with or alleviated by confidence in physician, was reported as lower after viewing the model with the physician.

Finally, not only were there no differences in survey results between in-person and telemedicine visits, but patients also reported the digital 3D model made the telemedicine visits as effective as an in-person visit. Although the concept of telemedicine is straightforward, implementation for complex discussions, such as cancer care, has been difficult due to the technical nature of these discussions and the limited means to share data virtually. Since the COVID-19 pandemic relieved many of the reimbursement and legal restrictions on telemedicine, virtual visits may continue to increase for patients reluctant or unable to travel long distances for care and for hospitals and providers with limited facilities or resources. In this setting, physicians will continue to look for adjunctive methods to increase the quality of the virtual visit.

Our study has several limitations. First, this is a single-surgeon, single arm study at one institution, so the results may not be transferrable to other institutions. The results may be biased given the absence of a control arm; however, the patient comments associated with the Likert scores seem to indicate that the model was strongly contributory to the scores. Second, this is a relatively small and homogenous patient cohort. Finally, this is a pilot study, and given that format the survey was short, combining many of the elements of longer, validated surveys in the domains of patient satisfaction, shared decision making, and decisional conflict.

CONCLUSIONS

In patients undergoing consultation for renal masses, the use of a digital 3D model was well received by patients, leading to increased knowledge and confidence in treatment, decreased anxiety, easier choice of treatment and physician, and better functioning telehealth visits. Future work should focus on broadening the scope of the survey to include validated surveys for patient satisfaction, shared decision making, and decisional conflict.

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