# Evidence Search Service Results of your search request

## 3D printing and Coronavirus

**ID of request:** 22997  
**Date of request:** 30th April, 2020  
**Date of completion:** 1st May, 2020

If you would like to request any articles or any further help, please contact:  Rhys Whelan at [library.morriston@wales.nhs.uk](mailto:library.morriston@wales.nhs.uk)

Please acknowledge this work in any resulting paper or presentation as: Evidence search: 3D printing and Coronavirus. Rhys Whelan. ( 1st May, 2020). ABERTAWE/SWANSEA, UK: Bwrdd Iechyd Prifysgol Bae Abertawe Library Services.

**Date range used** (5 years, 10 years): No date range   
**Limits used** (gender, article/study type, etc.): No limits   
**Search terms and notes** (full search strategy for database searches below):

I have searched Medline, Embase and WHO COVID-19 Database with the search terms below.

Medline- 8

Embase-7

WHO COVID-19 Database-7

There were a total of 22 papers after removal of duplicates- 14.

The Nexis search returned 1584 newspaper articles.

For more information about the resources please go to: <http://www.sblibraryservices.wales.nhs.uk/home>.

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### [B. Search History](#SearchHistory)

## A. Original Research

1. **3-D Printed Protective Equipment during COVID-19 Pandemic**  
   Wesemann C. Materials 2020;13:24.

While the number of coronavirus cases from 2019 continues to grow, hospitals are reporting shortages of personal protective equipment (PPE) for frontline healthcare workers. Furthermore, PPE for the eyes and mouth, such as face shields, allow for additional protection when working with aerosols. 3-D printing enables the easy and rapid production of lightweight plastic frameworks based on open-source data. The practicality and clinical suitability of four face shields printed using a fused deposition modeling printer were examined. The weight, printing time, and required tools for assembly were evaluated. To assess the clinical suitability, each face shield was worn for one hour by 10 clinicians and rated using a visual analogue scale. The filament weight (21-42 g) and printing time (1:40-3:17 h) differed significantly between the four frames. Likewise, the fit, wearing comfort, space for additional PPE, and protection varied between the designs. For clinical suitability, a chosen design should allow sufficient space for goggles and N95 respirators as well as maximum coverage of the facial area. Consequently, two datasets are recommended. For the final selection of the ideal dataset to be used for printing, scalability and economic efficiency need to be carefully balanced with an acceptable degree of protection.

1. **3D Printing beyond Dentistry during COVID 19 Epidemic: A Technical Note for Producing Connectors to Breathing Devices**  
   Cavallo Leonardo Prosthesis 2020, Vol. 2, Pages 46-52 2020;:No page numbers.

(1) Background: To mitigate the shortage of respiratory devices during the Covid-19 epidemic, dental professional volunteers can contribute to create printed plastic valves, adapting the dental digital workflow and converting snorkeling masks in emergency CPAP (continuous positive airways pressure) devices The objective of this report was to provide the specific settings to optimize printing with the 3D printers of the dental industry (2) Methods: In order to provide comprehensive technical notes to volunteer dental professionals interested in printing Charlotte and Dave connectors to breathing devices, the entire digital workflow is reported (3) Results: The present paper introduces an alternative use of the dental Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) machinery, and reports on the fabrication of a 3D printed connection prototypes suitable for connection to face masks, thereby demonstrating the feasibility of this application (4) Conclusions: This call for action was addressed to dentists and dental laboratories who are willing to making available their experience, facilities and machinery for the benefit of patients, even way beyond dentistry

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=fe2ce9ecc8a0c86b20889b80bb9adee3)

1. **3D-printed face protective shield in interventional radiology: Evaluation of an immediate solution in the era of COVID-19 pandemic**  
   Sapoval M. Diagnostic and Interventional Imaging. 2020;:No page numbers.

Purpose: The purpose of this study was to report the clinical evaluation of a 3D-printed protective face shield designed to protect interventional radiologists from droplet transmission of the SARS-Cov-2. Material(s) and Method(s): A protective face shield consisting in a standard transparent polymerizing vinyl chloride (PVC) sheet was built using commercially available 3D printers. The 3D-printed face shield was evaluated in 31 interventional procedures in terms of ability to perform the assigned intervention as usual, quality of visual comfort and tolerance using a Likert scale (from 1, as very good to 5, as extremely poor). Result(s): The mean rating for ability to perform the assigned intervention as usual was 1.7 +/- 0.8 (SD) (range: 1-4). The mean visual tolerance rating was 1.6 +/- 0.7 (SD) (range: 1-4). The mean tolerability rating was 1.4 +/- 0.7 (SD) (range: 1-3). Conclusion(s): The 3D-printed protective face shield is well accepted in various interventions. It may become an additional option for protection of interventional radiologists. Copyright © 2020 Societe francaise de radiologie

1. **Additive Manufacturing Can Assist in the Fight Against COVID-19 and Other Pandemics and Impact on the Global Supply Chain**  
   Larrañeta Eneko 3D Printing and Additive Manufacturing 2020;:No page numbers.

The high demand on medical devices and personal protective equipment (PPE) during the COVID-19 crisis left millions of health care professionals unprotected in the middle of this situation, as gove

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=1ab27dca81ee0deec6882edea28c52d7)

1. **Applications of 3D Printing Technology to Address COVID-19 Related Supply Shortages**  
   Ishack S. American Journal of Medicine 2020;21:21.

1. **COVID-19 and the role of 3D printing in medicine**  
   Tino Rance 3D Printing in Medicine 2020;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=45435c11596e20635a97e0e0057219a6)

1. **Helmet Modification to PPE With 3D Printing During the COVID-19 Pandemic at Duke University Medical Center: A Novel Technique**  
   Erickson M. M. Journal of Arthroplasty. 2020;:No page numbers.

Care for patients during COVID-19 poses challenges that require the protection of staff with recommendations that health care workers wear at minimum, an N95 mask or equivalent while performing an aerosol-generating procedure with a face shield. The United States faces shortages of personal protective equipment (PPE), and surgeons who use loupes and headlights have difficulty using these in conjunction with face shields. Most arthroplasty surgeons use surgical helmet systems, but in the current pandemic, many hospitals have delayed elective arthroplasty surgeries and the helmet systems are going unused. As a result, the authors have begun retrofitting these arthroplasty helmets to serve as PPE. The purpose of this article is to outline the conception, design, donning technique, and safety testing of these arthroplasty helmets being repurposed as PPE. Copyright © 2020 Elsevier Inc.

1. **How 3 D printing can prevent spread of Covid-19 between health care professionals during times of critical shortage of Protective Personal Equipment**  
   Maracaja Luiz Journal of Cardiothoracic and Vascular Anesthesia 2020;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=c465c0416451d5f9d7211688ba0d9960)

1. **Multicentre Evaluation of MRI-based Radiomics Features: A Phantom Study**  
   Rai R. Medical physics. 2020;11:No page numbers.

INTRODUCTION: This work describes the development of a novel radiomics phantom designed for MRI that can be used in a multi-centre setting. The purpose of this study is to assess the stability and reproducibility of MRI-based radiomics features using this phantom across different MRI scanners. METHODS & MATERIALS: A set of phantoms were 3D printed using MRI visible materials. One set of phantoms were imaged on seven MRI scanners and one was imaged on one MRI scanner. Radiomics analysis of the phantoms, which included first order features, shape and texture features was performed. Intraclass correlation coefficient (ICC) was used to assess the stability of radiomics features across 8 scanners and the reproducibility of two printed models on one scanner. Coefficient of variation (COV) was used to assess the reproducibility of radiomics measurements in the phantom on a single scanner. RESULT(S): The phantom models provide sufficient signal-to-noise and contrast in all the tumor models permitting robust automatic segmentation. During a 12-month period of monitoring, the phantom material was stable with T1 and T2 of 150.7 +/- 6.7 ms and 56.1 +/- 3.9 ms, respectively. Of all the radiomics features computed, 34/69 had COV less than 10%. Features from first order statistics were the most robust in stability across the eight scanners with 8/12 (67%) having high stability. 29/50 (58%) texture features had high stability and no shape features had high stability features across the eight scanners. CONCLUSION(S): A novel MRI radiomics phantom has been developed to assess the reproducibility and stability of MRI-based radiomics features across multiple institutions. The variation in radiomic feature stability demonstrates the need for caution when interpreting these features for clinical studies. Copyright This article is protected by copyright. All rights reserved.

1. **The role of additive manufacturing and antimicrobial polymers in the COVID-19 pandemic**  
   Zuniga Jorge M. 2020;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=31eb89644925a7b7803f81dabcb29d6c)

1. **A small 3D-printing model of macroadenomas for endoscopic endonasal surgery**  
   Huang X. Pituitary 2019;22:46-53.

PURPOSE: This paper examines the application of 3D printing technology in the endoscopic endonasal approach for the treatment of macroadenomas.

1. **3D task-transfer function representation of the signal transfer properties of low-contrast lesions in FBP- and iterative-reconstructed CT**  
   Robins M. Medical Physics 2018;45:4977-4985.

PURPOSE: The purpose of this study was to investigate how accurately the task-transfer function (TTF) models the signal transfer properties of low-contrast features in a non-linear commercial CT system.

1. **High-precision modular microfluidics by micromilling of interlocking injection-molded blocks**  
   Owens C. E. Lab on a Chip 2018;18:890-901.

Wider use and adaptation of microfluidics is hindered by the infrastructure, knowledge, and time required to build prototype systems, especially when multiple fluid operations and measurements are required. As a result, 3D printing of microfluidics is attracting interest, yet cannot readily achieve the feature size, smoothness, and optical transparency needed for many standard microfluidic systems. Herein we present a new approach to the design and construction of high-precision modular microfluidics, using standard injection-molded blocks that are modified using micromilling and assembled via elastically averaged contacts. Desktop micromilling achieves channel dimensions as small as 50 mum depth and 150 mum width and adhesive films seal channels to allow internal fluid pressure of >400 kPa. Elastically averaged connections between bricks result in a mechanical locating repeatability of ~1 mum, enabling fluid to pass between bricks via an O-ring seal with >99.9% reliability. We demonstrated and tested block-based systems for generating droplets at rates above 9000 min<sup>-1</sup> and COV <3%, and integrated optical sensors. We also show how blocks can be used to build easily reconfigurable interfaces with glass microfluidic devices and imaging hardware. Microfluidic bricks fabricated by FDM and SLA 3D printing cannot achieve the dimensional quality of molded bricks, yet 3D printing allows customized bricks to be integrated with standard LEGOs. Our approach enables a wide variety of modular microfluidic units to be built using a widely available, cost-effective platform, encouraging use in both research and education.

1. **Accuracy and precision of occlusal contacts of stereolithographic casts mounted by digital interocclusal registrations**  
   Krahenbuhl J. T. Journal of Prosthetic Dentistry 2016;116:231-6.

STATEMENT OF PROBLEM: Little peer-reviewed information is available regarding the accuracy and precision of the occlusal contact reproduction of digitally mounted stereolithographic casts.

### Opening Internet Links

The links to internet sites in this document are 'live' and can be opened by holding down the CTRL key on your keyboard while clicking on the web address with your mouse

### Full text papers

Links are given to full text resources where available. For some of the papers, you will need an **NHS OpenAthens Account**. If you do not have an account you can [register online](https://openathens.nice.org.uk/).

You can then access the papers by simply entering your username and password. If you do not have easy access to the internet to gain access, please let us know and we can download the papers for you.

### Guidance on searching within online documents

Links are provided to the full text of each document. Relevant extracts have been copied and pasted into these results. Rather than browse through lengthy documents, you can search for specific words as follows:

**Portable Document Format / pdf / Adobe**  
Click on the Search button (illustrated with binoculars). This will open up a search window. Type in the term you need to find and links to all of the references to that term within the document will be displayed in the window. You can jump to each reference by clicking it.

**Word documents**  
Select Edit from the menu, the Find and type in your term in the search box which is presented. The search function will locate the first use of the term in the document. By pressing 'next' you will jump to further references.

## B. Search History

|  | **Source** | **Criteria** | **Results** |
| --- | --- | --- | --- |
| 0. |  | Medline | 0 |
| 1. |  | exp \*betacoronavirus/ or exp \*Coronavirus infection/ | 12748 |
| 2. |  | ((corona\* or corono\*) adj1 (virus\* or viral\* or virinae\*)).ti,ab. | 527 |
| 3. |  | ((novel or new or nouveau or "2019") adj2 (coronavirus\* or "corona virus\*" or coronovirus\* or coronavirinae\*)).ti,ab. | 3180 |
| 4. |  | (Wuhan\* or Hubei\* or Huanan or "2019-nCoV" or 2019nCoV or nCoV2019 or "nCoV-2019" or "COVID-19" or COVID19 or "CORVID-19" or CORVID19 or "WN-CoV" or WNCoV or "HCoV-19" or HCoV19 or CoV or "2019 novel\*" or Ncov or "n-cov" or "SARS-CoV-2" or "SARSCoV-2" or "SARSCoV2" or "SARS-CoV2" or SARSCov19 or "SARS-Cov19" or "SARSCov-19" or "SARS-Cov-19" or Ncovor or Ncorona\* or Ncorono\* or NcovWuhan\* or NcovHubei\* or NcovChina\* or NcovChinese\*).ti,ab. | 16134 |
| 5. |  | (("seafood market\*" or "food market\*") adj10 (Wuhan\* or Hubei\* or China\* or Chinese\* or Huanan\*)).ti,ab. | 58 |
| 6. |  | 1 or 2 or 3 or 4 or 5 | 25003 |
| 7. |  | exp Printing, Three-Dimensional/ | 5007 |
| 8. |  | "Three-Dimensional Printing".ti,ab. | 1215 |
| 9. |  | "Three Dimensional Printing".ti,ab. | 1215 |
| 10. |  | "3 Dimensional Printing".ti,ab. | 200 |
| 11. |  | "3D Printing".ti,ab. | 4839 |
| 12. |  | "3-D Printing".ti,ab. | 217 |
| 13. |  | "digital manufacturing".ti,ab. | 34 |
| 14. |  | "Additive Manufacturing".ti,ab. | 1886 |
| 15. |  | "3D Prototyping".ti,ab. | 20 |
| 16. |  | "3D Fabrication".ti,ab. | 84 |
| 17. |  | 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 | 9687 |
| 18. |  | 6 and 17 | 8 |
| 0. |  | Embase | 0 |
| 1. |  | exp \*betacoronavirus/ or exp \*Coronavirus infection/ | 10493 |
| 2. |  | ((corona\* or corono\*) adj1 (virus\* or viral\* or virinae\*)).ti,ab. | 631 |
| 3. |  | ((novel or new or nouveau or "2019") adj2 (coronavirus\* or "corona virus\*" or coronovirus\* or coronavirinae\*)).ti,ab. | 2902 |
| 4. |  | (Wuhan\* or Hubei\* or Huanan or "2019-nCoV" or 2019nCoV or nCoV2019 or "nCoV-2019" or "COVID-19" or COVID19 or "CORVID-19" or CORVID19 or "WN-CoV" or WNCoV or "HCoV-19" or HCoV19 or CoV or "2019 novel\*" or Ncov or "n-cov" or "SARS-CoV-2" or "SARSCoV-2" or "SARSCoV2" or "SARS-CoV2" or SARSCov19 or "SARS-Cov19" or "SARSCov-19" or "SARS-Cov-19" or Ncovor or Ncorona\* or Ncorono\* or NcovWuhan\* or NcovHubei\* or NcovChina\* or NcovChinese\*).ti,ab. | 17700 |
| 5. |  | (("seafood market\*" or "food market\*") adj10 (Wuhan\* or Hubei\* or China\* or Chinese\* or Huanan\*)).ti,ab. | 54 |
| 6. |  | 1 or 2 or 3 or 4 or 5 | 23766 |
| 7. |  | exp Printing, Three-Dimensional/ | 10407 |
| 8. |  | "Three-Dimensional Printing".ti,ab. | 1364 |
| 9. |  | "Three Dimensional Printing".ti,ab. | 1364 |
| 10. |  | "3 Dimensional Printing".ti,ab. | 230 |
| 11. |  | "3D Printing".ti,ab. | 6031 |
| 12. |  | "3-D Printing".ti,ab. | 280 |
| 13. |  | "digital manufacturing".ti,ab. | 37 |
| 14. |  | "Additive Manufacturing".ti,ab. | 1742 |
| 15. |  | "3D Prototyping".ti,ab. | 27 |
| 16. |  | "3D Fabrication".ti,ab. | 73 |
| 17. |  | 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 | 12549 |
| 18. |  | 6 and 17 | 7 |

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