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1/21

3D printing

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interview

"3D printing in dentistry is much more than just a new technology"

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Dr George Freedman

Editor-in-chief

3D printing: Revolution in dentistry

3D printing has arrived in dentistry. Like with the other great paradigm shifts of the past 50 years in the profession (cosmetic dentistry, implants and diagnostics), major advances are very apparent on the near horizon. The needs are many, the technologies numerous, the applications almost unlimited and the potential open-ended. Just like cosmetic materials and techniques brought aesthetic restorative dentistry into the hands of every practitioner, 3D printing promises to bring functional and artistic control of the restorative process into the chairside setting.

The digital transformation of dentistry, including CBCT, intra-oral and extra-oral scanning, milling of ceramic and composite materials, and robotic implant placement, is firmly established.

Stereolithography, first developed in the 1980s, was soon followed by additive manufacturing, the deposition of material in increments. Dental applications are more recent. 3D printing has been utilised for rapid prototyping and modelling for more than a decade. The size and cost of the earlier printers meant that they were limited to larger laboratories. The most recent desktop printers have a much smaller footprint, are easily affordable for the single practitioner, communicate with existing software platforms and offer high levels of precision with a wide range of materials.

Current 3D printers are fully capable of managing the great demand for temporary, transitional, and permanent restorations and appliances and of achieving the clinical excellence required by the dental profession. Consequently, there has been a growing acceptance of this transformative technology. Increasingly, 3D printing is viewed as an industry game-changer and a forecast of the future direction of the dental practice.

3D-printing techniques include stereolithography, fused deposition modelling, selective laser sintering, powder binder printing, photopolymer jetting, electron beam melting and direct light processing.

The documented, wide-ranging 3D-printing applications can be grouped by treatment category:

- *Fixed prosthodontics:* Permanent and provisional indirect restorations (crowns, onlays, inlays, bridges) and permanent monobloc direct restorations can all be custom-fabricated chairside within minutes of scanning the preparation.
- *Removable prosthodontics:* Both complete and partial dentures, including digital occlusal design, are deliverable within hours.
- *Implant dentistry:* 3D printing of surgical guides has facilitated ideal implant positioning. Biomimetic custom 3D-printed bone implants replace missing segments, minimising stress transfer to the remaining bone.
- *Orthodontics:* Aligners, designed using CBCT data and artificial intelligence extrapolation of tooth movement over time, are 3D-printed.
- *Endodontics:* The pioneering 3D-printed endodontic access guide, utilising CBCT data, translates presurgical planning into clinical success.
- *Maxillofacial surgery:* Custom-designed bone grafts and fixation plates expedite both the surgical procedure and the healing process.
- *Periodontics:* 3D-printed guides that relieve and retract gingival margins offer aesthetic gingival correction. Soft-tissue printing is currently in the research phase.

3D-printing techniques and procedures are high-quality, high precision, accurate and significantly lower in cost than conventional treatment options. Dentists save money: many desktop printers cost between US$3,000 and US$10,000, and dental 3D-printing materials cost pennies per tooth. Patients save money, by the elimination of intermediate procedures and transportation costs. Treatment is faster, typically same-day services.

Welcome to 3D printing! Welcome to the future of dentistry!

Dr George Freedman
Editor-in-chief

page 24

page 42

page 56

editorial

3D printing: Revolution in dentistry 03
Dr George Freedman

industry

Dental 3D printing adoption across Asia Pacific—Top three trends and forecast? 06
Kiavash Bakrani & Dr Kamran Zamanian

Fraunhofer bringing future technologies into the present 10
Jeremy Booth

3D printing in dentistry: Future-proof technology? 14
Iveta Ramonaite

opinion

3D printing: Changing the game 16
Dr Florin Lăzărescu

3D printing promotes individuality and creativity 18
Christian Ehrensberger

interview

"Digital technologies are fundamentally changing the dynamics of our industry" 20
An interview with Stephan Kreimer

"3D printing in dentistry is much more than just a new technology" 24
An interview with Patrick Thurm

Fast, affordable and aesthetic 3D-printed dental restorations 28
An interview with Thomas Kwiedor

How 3D printing has transformed dental care 32
An interview with Georgio Haddad

"Our service meets all of the needs that arise in the dental clinic and laboratory" 34
An interview with Riccardo Molinelli

trends & applications

Printing clear aligners in-house—how accessible is it? 38
Jeremy Booth

Digital orthodontics company raises funds for 3D-printed brackets 40
Jeremy Booth

user report

Fully digital workflow for producing an individual occlusal splint 42
Sokratis Gonidis

news

3D-printed indirect bonding tray resin aims to halve orthodontic chair time 44
Jeremy Booth

Imagine the CADabilities 45
exocad

Study highlights benefits of in-house 3D printing for immediate dental implant placement 46
Iveta Ramonaite

case report

Guided applications for partial extraction therapy 48
Drs Scott D. Ganz & Isaac Tawil

A fully digital workflow in implant and restorative dentistry 58
Drs Anthony Mak & Andrew Chio

industry report

GC Temp PRINT—a versatile material 56
Stephen Lusty

manufacturer news 66

meetings

International events 72

about the publisher

submission guidelines 73
international imprint 74

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Dental 3D printing adoption across Asia Pacific

Top three trends and forecast

By Kiavash Bakrani & Dr Kamran Zamanian, Canada

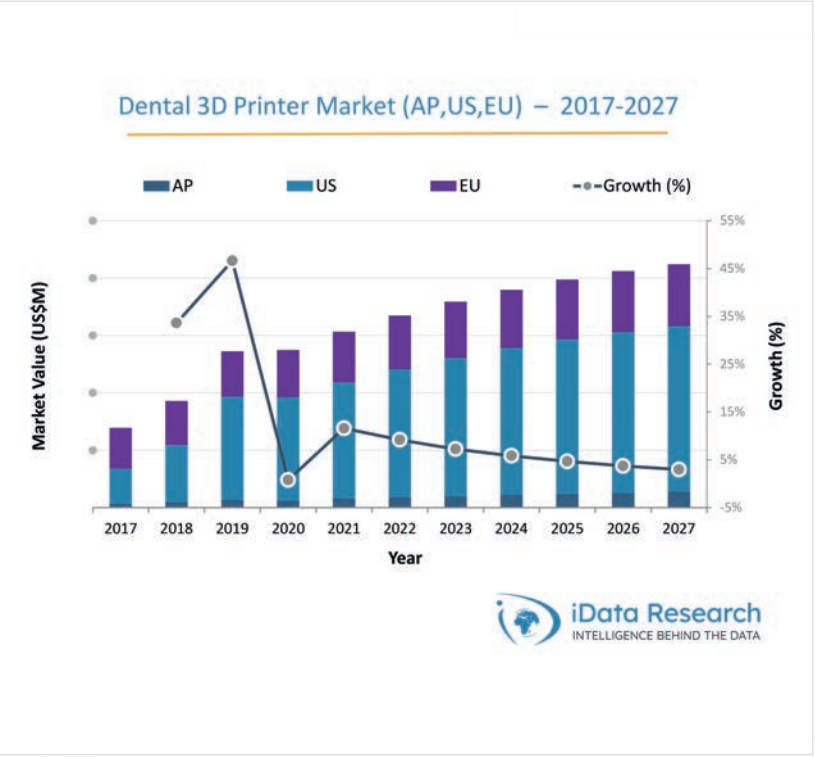

Fig. 1: Asia Pacific, US and European 3D printer markets.

The digital dentistry market in Asia Pacific has started to gain traction because of technological advances and the demand for improved precision, although the markets lag severely behind North America and Europe.

Dental 3D printing has rapidly become an important part of many digital dentistry workflows in countries such as Australia, Japan and South Korea. Dental 3D printers are now an increasingly popular tool in dental laboratories, dental practices and orthodontic practices and have many uses, including the production of crown and bridge models and final prostheses. Whereas the dental 3D printer segment is the smallest segment of the digital dentistry market, it has grown the most rapidly in recent years. Countries such as China and India, who lag behind in terms of novel technology, have not seen nearly as much advancement.

Trend #1: Technological advancements lead to growth opportunities

Dental 3D printing allows for significant time savings for a variety of applications, which is a common feature of most digital dentistry technology. Production of models, surgical guides, night guards and other products is extremely rapid and requires minimal labour. Models, in particular, are often quite laborious to produce traditionally, making this a significant opportunity for time savings. The enhanced productivity offered by digital workflows will continue to drive growth in the dental 3D printing market. Ongoing regulatory approvals of materials for new indications will result in significant growth in the dental 3D printer market. Whereas 3D-printed dental prosthetics are not yet available in many Asia Pacific countries, such approval is likely to induce significant market value growth when it occurs. A single dental 3D printer from a major manufacturer is generally capable of producing surgical guides, models, night guards, dentures and temporary crowns; the technology is, therefore, very versatile, and growth hinges largely on the materials approved for use.

Trend #2: Technological learning curves and regulatory approvals delay market growth

Dental 3D printers are still relatively new technology and tend not to be overly user friendly. A steep learning curve is often involved in the incorporation of dental 3D printing into a digital workflow, limiting access for less technologically adept dentists and dental laboratory technicians. Similar issues limited the growth of the chairside CAD/CAM system market in Asia Pacific; significant time must be invested in learning the technology, and strong customer support from manufacturers is key to success. As dental 3D printers become more user-friendly, this issue will be mitigated, but for the time being, it limits the potential for growth in the Asia Pacific market.

Regulatory approvals for new indications are required for products in the Asia Pacific market. Currently, many of the newest innovations in the CAD/CAM material market are unavailable in Asia Pacific, and it is unknown when they will be approved. This uncertainty limits the potential for market growth.

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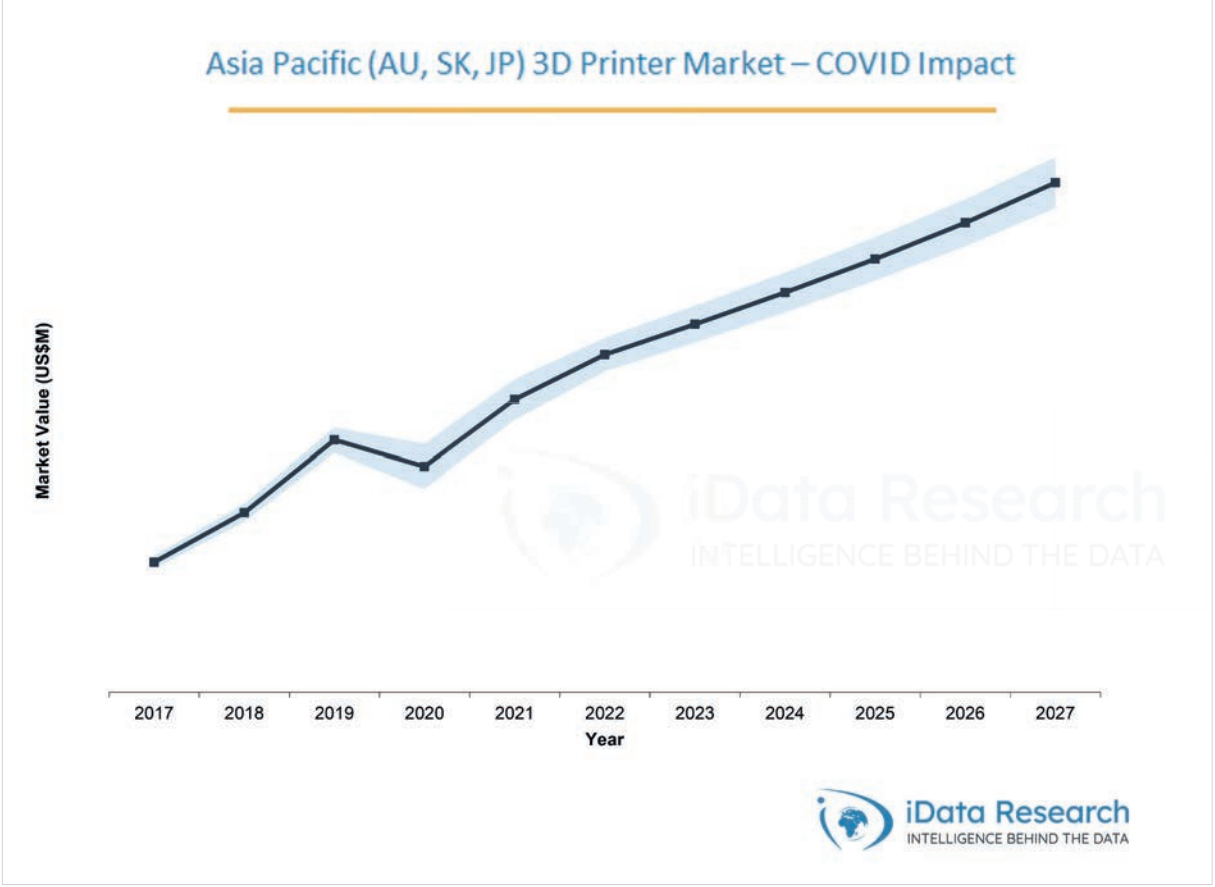

Fig. 2: Impact of COVID-19 on the 3D printer market in Asia Pacific.

Trend #3: COVID-19's impact on the Asia Pacific market

The global dental market was significantly affected by the COVID-19 pandemic, and Asia Pacific was no exception. The markets for dental prosthetics as well as CAD/CAM devices and materials are interdependent and have, therefore, also been similarly affected. The overall market value for dental prosthetics decreased dramatically compared with the previous year because of the elective nature of the procedures and the tight regulations that led to the closure of many dental clinics. Owing to its high price point, the premium market was impacted the most notably. The total market is expected to recover in 2021 and continue to grow at a moderate pace.

3D dental printers market forecast

Overall, the dental 3D printer market in Asia Pacific experienced a decline in 2020 because of reduced dental spending across the nation. This decline is temporary, and the market will return to normal unit sales forecasts by 2022. For the remainder of the forecast period, the dental 3D printer market in Asia Pacific is expected to experience strong unit sales growth; as more laboratories go digital and more CAD/CAM materials receive regulatory approval, the demand for 3D printers will increase.

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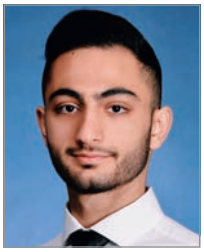
about



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