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CAD-CAM in Pediatric Dentistry: A Review

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ABSTRACT:-

The creation of dental prostheses and appliances for children using traditional procedures might present a number of difficulties, including lengthy and repeated consultations and accurate prosthesis fitting. Due to several clinical dental considerations, the standard impressionmaking techniques in paediatric patients are frequently challenging. In the present day, computer-aided design and production are being looked at to replace current practises. Paediatric dentistry treatments utilising CAD/CAM for the creation of different dental appliances have a huge potential to provide youngsters with high-quality oral healthcare. The majority of the appliances and restorations used to protect and repair the oral cavity are highly individualised. As more technology is incorporated into paediatric dentistry, CAD/CAM continues to gain relevance and provide patients benefits that are unmatched.

Keywords:-Computer-aided design (CAD) and computer-aided manufacturing technolog, pediatric dentistry, digital-impression technique, modern digital pediatric dentistry

Introduction:-

The use of computer-aided design (CAD) entails the exact design and production of three-dimensional models for products including crowns, veneers, onlays, inlays, and bridges. Using this technique, dentures, mouthguards, and various types of orthodontic therapy may all be produced.1 The area of paediatric dentistry is using more computer-aided design/computer-aided manufacturing (CADCAM)/three-dimensional printing (3Dprinting) technology in the creation of various prostheses and appliances as well as in various dental treatment methods.2 These extremely delicate processes may now be managed more precisely than ever thanks to sophisticated software. An automated milling machine receives the data from computer-aided manufacturing (CAM). Precise metal-free product, digital production process, surface texture that can't be seen, ease of only one dental visit, Excellent fit and functionality, long-lasting, and durable.The quality of ceramic restorations has substantially improved over the past few years because to (CAD/CAM) technology.3 The concept of porcelain restorations created with CAD/CAM having poor marginal integrity is already a thing of the past. Improvements in the cutting method, software design, and digital impressions have all contributed to excellent outcomes. The patient's selection, proper marginal design, and tissue retraction are crucial elements that must be rigorously adhered to in all restorative treatments. The major benefits of using CAD/CAM technology for restorations include: shorter clinical times, faster restoration manufacturing, elimination of the need for traditional impression-taking techniques, stable colour of ceramics, and good cosmetic results. By giving the paediatric dentist more treatment choices, CAD/CAM has improved the design and use of paediatric dental restorations. Numerous CAD/CAM systems have been created since the 1980s. A variety of methods, including stereolithography, fused filament manufacturing (FDM), selective laser sintering/melting, electron beam melting, digital light processing, inkjet 3D printing, and polyjet, can be used to create digital 3D objects. A camera, a computer display, and software make up an intraoral scanner (IOS), a tool for capturing the direct optical imprints of oral structures. These tools direct a laser beam or a structured light beam to the target item (like dental arches) for scanning. A range of materials, including ceramic, hydroxyapatite, plaster, metals, polycaprolactone, polylactic acid, and acrylic butadiene styrene, can be used to create 3D-printed products, dental equipment, and prosthetics.[1-5]

Impresssion of oral tissues:-

The painful impression-taking process in paediatric dentistry has been modernised by CAD/CAM, Intraoral scanners, which make it more kid-friendly and acceptable. With its digital workflow, the process has also become more simpler and speedier. STL files are transferred directly to the digital dentistry laboratory without any interruptions, unlike with earlier, more traditional techniques. It saves the kid and the dentist both time and impression material, which is very beneficial.[6–9] in a research by Aarash et al. Intraoral scanners have demonstrated positive outcomes when used as a supplement or substitute for traditional impression procedures.

Fabrication of space maintenance:-

To create space maintainers using CADCAM or 3D printing technology with better precision and convenience in the digital process, the hard and soft tissues of the oral cavity have been scanned digitally in three dimensions. This novel technique allows for the manufacturing of the Band and Loop space maintainer for a paediatric patient with mixed dentition stage. The dental cast can be digitally scanned using a 3D dental scanner and then digitally created. After taking a digital image using intraoral scanners, removable space maintainers may be created for paediatric patients utilising CADCAM technology and Polyether ether ketone (PEEK) material. Studies have shown that PEEK-made space maintainers are successful in terms of comfort and happiness.[17]

Management of cleft lip, cleft palate patient:-

Due to impression material, dislodgment, or airway blockage, taking an imprint for the fabrication of the obturator in a newborn or child with cleft lip and palate is a technique-sensitive process. The intraoral scanning techniques have provided cleft patients with safer, more efficient, and precise intraoral impressions. In compared to the traditional imprint procedure using alginate, digital scanning of the cleft areas for impressionmaking is quicker, more accurate, and safer. A recent research highlighted the three-dimensionally printed obturators known as Dclefts that are made using 3D printing technology to make it easier for newborns with Clefts to feed themselves using milk bottles for adequate nutrition.[21]

In restorative dentistry:-

With the aid of digital workflow and chairside CADCAM technology, paediatric patients can create digital impressions utilising intra-oral scanners for fast zirconia crown production. According to a research by Anil et al The dental office has chances to create full-contour restorations thanks to digital effect systems and chairside CAD/CAM equipment.[21]

For Myofuncrional appliance:-

Paediatric age groups with growth potential employ myofunctional gadgets to address malocclusion. The traditional methods for making these gadgets are quite time-consuming and challenging. In a recent lab study, the mechanical qualities of a functional regulator of Type 3 (FR3) created using CAD/CAM technology were compared to those of a traditional FR3 to determine which had superior mechanical properties.[27]

For dental education purposes:-

models created using 3D printing to simulate caries in order to execute pulpotomies and create stainless steel crowns. Such digital models created from a patient's radiographs can help visualise the breadth and size of a dental caries lesion as well as show the intricate morphology and unique variations of tooth structure. Patient education may benefit from it. Both the parent and the kid will be able to comprehend the prescribed treatment.Patients are more likely to comprehend the course of treatment when using CAD/CAM, according to studies..[15-20]

In sports dentistry:-

Nowadays, the majority of young children participate in sports, and mouthguards may be made using CADCAM/3D printing technology. Intraoral scanners may be used to obtain impressions, which is quite pleasant for young patients.Studies for this application are still being conducted.[28]

Management of dental and maxillofacial trauma:-

Prudent treatment strategies are needed for paediatric children who have malocclusion and oral-maxillofacial injuries. Combining digital dentistry with CAD/CAM and 3D printing to set the bite plane for surgical guidance in the treatment of an unstable mandibular fracture is an option since it should negatively influence both bone formation and the development of tooth germs. In the near future, it may be feasible to create custom splints utilising digitally scanned information from a CBCT scan.[12]

For removable orthodontic retainers:-

Customised detachable orthodontic retainers may be created using CADCAM and 3D printing technologies. Individualised orthodontic appliances have been produced using 3D intraoral scanning, cone beam computed tomography, 3D printing, and computer-aided design and computer-aided manufacturing technologies (CAD/CAM). Digital impressions, digital models, virtual articulators, face bows, wires, brackets, and other orthodontic tools are all part of the CAD/CAM process. Studies have produced favourable findings.[24]

Advantages of CAD/CAM in pediatric dentistry:-

Appliances and prostheses created with 3D printing are more precise and need fewer clinical and laboratory processes during processing. For the patient's safety, it is preferable that there is no gag reflex elicitation, no risk of foreign body aspiration, and no dislodgment of impression material into the cleft area. Digital impressions have the ability to boost productivity, improve patient comfort, and lower long-term expenditures and expenses of the dental process.[15]

Disadvantages of CAD/CAMin pediatric dentistry:-

higher expense of digital machinery and equipment. Using 3D-printed appliances or prosthetics poses a health risk due to the usage of uncured monomer or polymer resins. Another important consideration is the IOS's appropriate size for scanning the oral cavity, particularly for paediatric patients who need to have impressions taken for dental prosthetics or equipment.[16]

Conclusion:-

Children's primary and permanent dentition can greatly benefit from the use of CAD/CAM technology. This technology may be used in many different ways, however in order for digital dentistry equipment to be more useful in paediatric dentistry, research must be done to enhance them. Although there are a number of benefits to this technology, there is always opportunity for improvement to eliminate the drawbacks. Therefore, CAD-CAM-based digital paediatric dentistry has a wide range of applications in the field of paediatric dentistry.

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