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(Book Chapter)

Editor

Dr. Sourabh Jain

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Editor

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ARTIFICIAL INTELLIGENCE AND AUTOMATED CEPHALOMETRY IN ORTHODONTICS: A DYNAMIC UPDATE

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Abstract- Artificial Intelligence (AI) comprises of Machine learning (ML) as well as Deep learning (DL). Artificial intelligence encompasses both hardware as well as software that can perceive its environment and take an action that maximizes its chances of achieving goals successfully.The characteristics of artificial intelligence is the ability to understand and rationalize things and take actions that have the best chance of achieving specific goal. Machine learning was the term coined by Arthur Samuel in 1952 which uses mixture of statistical and probabilistic tools wherein machines can improve their actions when new data is introduced. Deep learning (DL) is a sub-domain of Machine learning where the machine itself calculates specific features of the given input. DL is a successor of artificial neural network (ANN) which was initially developed in 1900's. With the newer technologies researchers have developed more complex networks for solving more complex problems. This neural network is now known as Deep learning. There are many applications of Artificial intelligence in various fields. One such application of AI is use of automated cephalometry in the field of Orthodontics. Which can be in CBCT (cone beam computed tomography), Lateral cephalogram, Frontal cephalogram etc? The applications of AI in automated cephalometry are numerous. Some of them are: Assessment of Upper airway, Maxillary and mandibular segmentation using CBCT, Planning for orthognathic surgeries, Assessment of sino-nasal cavity, Assessment of tooth and root positions before treatment planning and orthodontic treatment. Thus, artificial intelligence in automated cephalometry can help the Orthodontist or the healthcare practitioners in better understanding of the situation and proper diagnosis before fabrication of treatment plan.

1. INTRODUCTION

Artificial Intelligence is subfield of computer science which encompasses both hardware and software that can perceive its environment and take actions that maximizes its chances of achieving goals successfully. Artificial Intelligence refers to stimulation of human intelligence in machines that are programmed to think like humans and mimic their actions such as problem solving and learning. The characteristic of artificial intelligence is the ability to understand and rationalize things and take actions that have the best chance of achieving specific goal.

A subset of Artificial intelligence is Machine Learning (ML), which refers to the concept that computer programmes which can automatically learn from and adapt to new data without being assisted by humans. Deep learning techniques are used which enable this automatic learning through the absorption of huge amounts of unstructured data such as text, images or videos. Artificial Intelligence is used in fields where possible outcomes are limited, computational power is scarce or human intervention is essential. However, in healthcare fields Artificial intelligence may require a serious human intervention and input though making the outcome and procedure difficult yet possible.

Machine learning was the term coined by Arthur Samuel in 1952 which uses mixture of statistical and probabilistic tools wherein machines can improve their actions when new data is introduced.

This data processed could be various forms:

1. Predictions provided by the machine
2. New patterns identified from the data
3. Classification and sorting of new data

Deep learning (DL) is a sub-domain of Machine learning where the machine itself calculates specific features of the given input. DL is a successor of artificial neural network (ANN) which was initially developed in 1900's. With the newer technologies researchers have developed more complex networks for solving more complex problems. This neural network is now known as Deep learning.

Data mining is again a new concept where algorithms are applied to historical data to identify new relationships and pattern thereby helping the healthcare practitioners as well as improving quality of care.

2. ARTIFICIAL INTELLIGENCE/MACHINE LEARNING ALGORITHM

There are various types of Artificial intelligence/Machine learning algorithm

1. Artificial neural network
2. Convolutional neural network
3. Support vector machine
4. Regression
5. Random forest
6. Decision Tree
7. Bayesian networks
8. Expert systems
9. Pattern matching

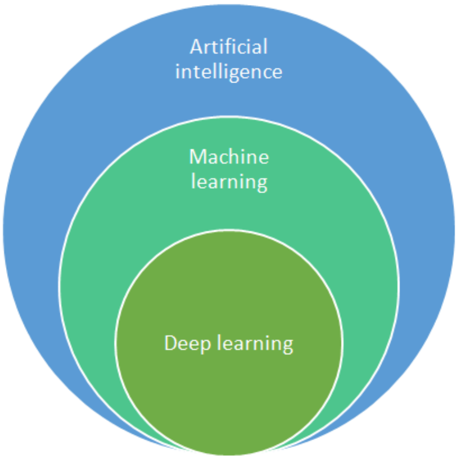

Figure 1 Artificial intelligence and its subsets

2.1. Application of Artificial Intelligence to Dentistry

1. Diagnosis and treatment planning

A. For TMJ assessments
B. Orthodontic extractions
C. Assessment of maxillary constrictions
D. Classification of skeletal patterns
E. Prediction of orthodontic treatment outcome
F. Prediction of Orthognathic surgeries
G. Assessment for Osteoporosis from Panoramic radiographs

2. Automated cephalometric landmarking/analysis

A. Lateral Cephalogram
B. CBCT
C. Frontal Cephalogram

3. Assessment of growth and development

A. Cervical vertebra maturation
B. Hand wrist radiographs assessment

4. Evaluation for treatment outcomes

A. Orthognathic Surgeries
B. Age perception
C. Facial appearance

5. Miscellaneous

A. Tooth segmentation from CBCT/Digital models
B. Detection of pattern of tongue musculature
C. Airway analysis

2.2. Applications of Artificial Intelligence with automated cephalometry to Orthodontics

The use of artificial intelligence in healthcare profession can be categorized into Diagnosis, treatment planning and treatment outcomes. Artificial intelligence can automate the manual work and speed up the process of diagnosis, treatment planning, treatment outcomes and growth pattern. Currently artificial intelligence has increased the demands for orthodontic profession to automate cephalometric analysis and several diagnostic tasks that were once carried out by clinician. The automation has been carried out with both 2D images (lateral cephalogram) and 3D images (CBCT) which help in accurate identification of landmarks and analysis for proper diagnosis of the case.

3. ARTIFICIAL INTELLIGENCE AND CEPHALOMETRY

Since the initial attempts for automated identification of landmarks on lateral cephalograms several approaches have been developed. They are broadly categorized as:

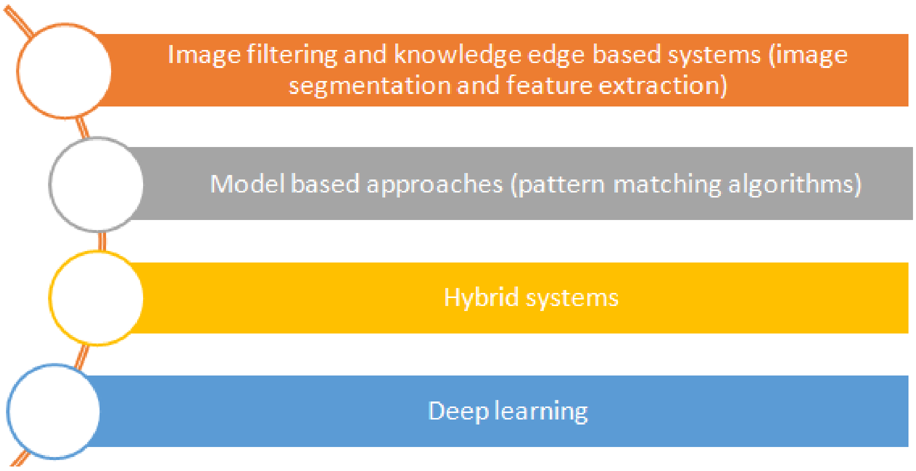

Figure 2 Various Approaches in Automated Cephalometry

With recent technologies and upgradation in artificial intelligence the artificial intelligence algorithms is capable of analysing and automatically identify cephalometric landmarks on radiological images in a fraction of second with comparable precision to experienced human examiners. With the help of 3D imaging fully automatic segmentation of maxillary and mandibular bones, upper airway and skeletal bone age assessment can be done. In 3D medical imaging segmentation is defined as the construction of 3D virtual surface models to match the volumetric data.

Manual segmentation is the method with greatest accuracy as it is based on the performance of one clinician. In the manual approach segmentation is performed slice by slice by the user. The software then combines all the slices to form a 3D volume. Issue with manual segmentation is that it is time consuming, tedious and requires precision by the user. Thus, automated methods are desirable as they are less time consuming and less tedious. This has led to tremendous innovations in CT and CBCT imaging helping is segmentation and reconstruction of structures in healthcare fields.

There are many applications of machine learning and deep learning in healthcare fields one of them is possibility to automatically segment the sino-nasal cavity and the pharyngeal airway in CBCT scan. Upper airway has been an area of interest for Orthodontics as well as in medical field as problems related to upper airway like breathing problems and snoring are common issues faced. There is also a trend in orthodontics to use patients airways quantitative data pre and post treatment to determine the effects of a particular intervention on the airway dimension.

Also, a further area of interest for fully automated segmentation from CBCT is the 3D reconstruction of teeth and root from CBCT images which is helpful in assessing the further futuristic tooth movements in complicated cases treated by the orthodontists which will again help in accurate diagnosis of the case and better treatment planning.

For orthodontic treatment planning, decision making expert system (ES), based on machine learning and artificial neural networks (ANN) have been designed. This expert system can not only help in assisting less experienced orthodontists and students but can help orthodontist in better understanding of the treatment plan. Artificial intelligence has its application in soft tissue outcomes after treatment. In this regard, ANN was used to forecast the change in lip curvature after orthodontic treatment with or without extractions.

4. CONCLUSION

Thus, Artificial intelligence and automated cephalometry can help the Orthodontist or the healthcare practitioners in better understanding of the situation and proper diagnosis before fabrication of treatment plan. Artificial intelligence works as a 'Second set of eyes' for the orthodontists and is helpful in making the patient understand the procedure of the treatment with better evidences. Though, accurate identification of landmarks gets more complicated when there are issues with image variability, image acquisition settings, subject demography and heterogeneity in malocclusion characteristics among subjects. Furthermore, various studies and researches are required in assessing the problem and standardization of the automated cephalometry in terms of software and well as hardware required for the procedure.

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COMPARATIVE AND EXPERIMENTAL ANALYSIS OF THE BIODEGRADABLE EDIBLE GLASSES

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Abstract- As sustainability has become more fashionable, many businesses have begun to use ecologically friendly accessories. This is especially important in the case of the disposable tableware request. Most plastic tools, paper plates, and Styrofoam carrying carriers are used only for a few hours before being discarded in a landfill for hundreds of generations before degrading. In recent years, efforts have been undertaken to develop single-use tableware that biodegrades in a shorter amount of time. Despite its widespread use, single-use glass has yet to receive an environmental update. This research paper emphasizes to design an experimental approach to replace single use plastic with edible glass and to standardize different concentrations of agar base to produce a feasible version of edible glass.
Keywords: Sustainability, disposable tableware, edible, agar.

1. INTRODUCTION

Solid waste disposal is a big challenge in the current situation. Due to rapid urbanization and population growth, several countries are experiencing major solid waste management issues. In many locations, the rise of industry has augmented the agony of solid wastes in open indentures has been a routine practice. Solid facades have accumulated, posing a serious threat to the health of vibrant living reality. Furthermore, land quality deteriorates over time.

Plastic items are one of them, and they are discarded in vast quantities, polluting the environment severely. According to a report published by the Central Pollution Control Board in 2018-19, India discards 3.3 million tones of single-use plastic per year. Deforestation, pollution, and fatal health problems are all consequences of their product, operation, and disposal. Attempts to make more ecologically friendly tableware have been made, however these solutions are never economically or logistically practicable. This design aimed to create a single-use cup that met the request's requirements while being biodegradable and supplied responsibly. The mug's potential to enter the assiduity is demonstrated by a financial and request analysis.

In recent years, there has been a lot of research into the use of non-toxic and edible biopolymers as film and coating materials in the food industry to avoid using carcinogenic and harmful petroleum products (Pizarro & Barrales, 1986; Renn, 1984; Alkahane & Izumi, 1976). Mill can be eaten on the go thanks to digestible packaging made of natural, biodegradable materials. There is no need for garbage collection, processing, recycling, or disposal. Increasing population growth, pollution, and energy are all major worldwide challenges that have led to the development and use of renewable and environmentally beneficial energy materials.

Natural macromolecules have received a lot of attention because of their biodegradability, low production cost, and good physical and chemical properties. Commercial agar has been widely investigated in recent years to see if it can be used in a variety of applications.

Agar is a gel-forming material that can be obtained from red seaweeds known as "agarophytes." Agar is a natural polymer that is biodegradable, hydrophilic, inexpensive, non-toxic, and chemically stable. Agarose is assumed to play a substantial effect in agar's mechanical behaviour, with agaropect in having a minor impact. Major objective of this study is to extract useful information from literature and other forms of publications in order to identify innovative ways to use natural products as raw materials and make ready-to-use objects that are environmentally friendly.

2. MATERIALS AND METHOD

2.1. Selection of biodegradable source

For implementation of the said objective Agarose powder was selected and used for the preparation of edible glasses (Fuse & Goto, 1971). Agarose is a linear polymer with a molecular weight of about 120,000 that is based on the-(1→3)-β-Dgalactopyranose-(1→ 4) 3,6-anhydro—L-galactopyranose unit; Agaropectin is a heterogeneous collection of smaller molecules that occur in lesser numbers (Watase & Nishinari, 1983). They have similar structures but are somewhat branched and sulfated, and methyl and pyruvic acid ketal substituent's are possible. They do not gel well and can be easily detached from the superior gelling agarose molecules by charging them. Alkaline treatment improves the quality of agar by converting any L-galactose-6-sulfate to 3, 6-anhydro-L-galactose.

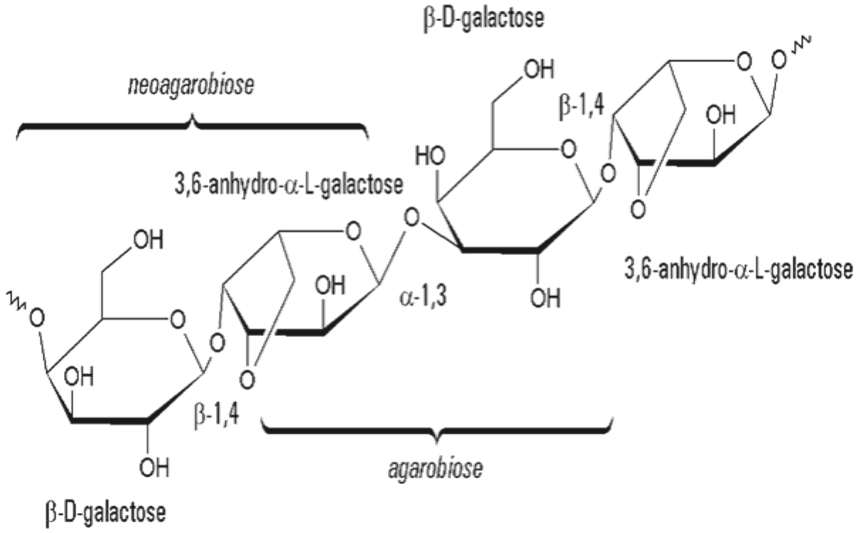

Figure1 Linear Polymer structure of Agarose

2.2. Standardization of different concentrations of Agarose

In order to make edible glasses, several amounts of agarose were explored. Standardization was done at two different concentrations: 6 grams per 500 ml and 10 grams per 500 ml. These agarose concentrations were chosen to test the product's stiffness.

2.3. Addition of Additives

The edible glasses were given a proper taste, flavor, and color to make the product more appealing and attractive. Green, yellow, and red were chosen as the primary colors. Again, three flavors were chosen for flavoring: cardamom, strawberry, and vanilla. Sugar was used to keep the cups' basic flavor sweet.

3. METHODOLOGY

The first hurdle was developing the optimal formulation for a cup-shaped product. The form was created using a silicon mold. If the amount of agar used is insufficient, the product will have a gelling texture and will be unable to maintain its shape. By increasing the agar content, a stiffer product with the desired texture was obtained (Figure 2).

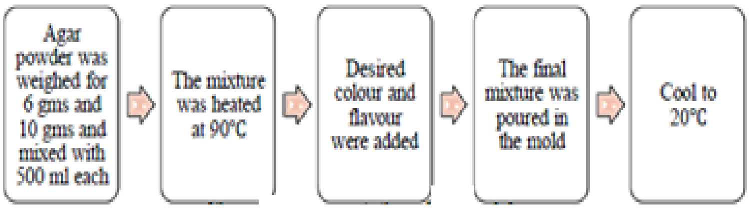

Figure 2 Representation of Methodology

4. RESULT

Several samples were made using varying amounts of water and agar, all of which were tested. Texture ranges from extremely delicate to quite firm. The most effective formulation is provided in Table 1.

Table 1 Observations obtained with different concentrations of Agarose

Formulation	Water (ml)	Agar (gm)	Observations
I	500	6	Semi-rigid, translucent
II	500	10	Rigid, semi opaque

Figure 3 Preparation of Edible glasses of different concentration

Figure 4 Edible Glasses – Chewable, Biodegradable and Sustainable

The edible glasses were also put through a shelf life test. The storage conditions offered to the items were found to be quite favorable. The edible glasses were kept at 4°C for storage. The glasses stayed in their original shape for seven days at 4°C.

When the same was observed after 10 days, the glasses began to lose their shape and deform (Figure 5).

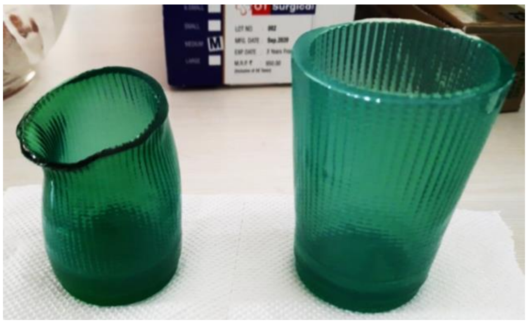

Figure 5 Deformation of Edible glasses when kept at 4°C for 10 days (left). Deformation of Edible glasses when kept at 4°C for 7 days (right)

5. CONCLUSION

The common misconception about environmentally friendly goods is that they are more expensive than regular goods. The reason for this is that the goods would have to undergo extensive research and development before becoming environmentally friendly. However, this is not always the case; these edible glasses are extremely affordable. It is feasible to employ a natural polymer to replace plastics. The objective of this study was met when a biodegradable and edible product was created.

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APPLICATION OF ARTIFICIAL INTELLIGENCE IN THE FIELD OF ORTHODONTICS

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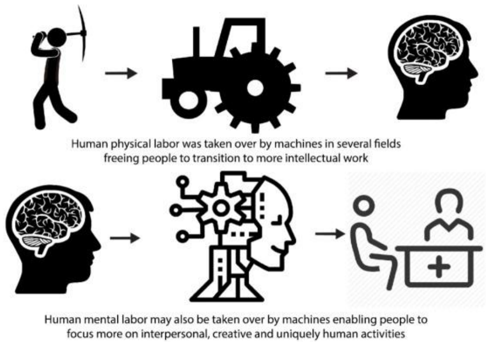
1. THE REVOLUTION

Throughout human history, our species has found ways to do any task more efficiently. The reduction in human physical labor and increasing specialization into fields requiring mental labor and skill has been made possible due to the industrial revolution and the machines developed since then. The digital revolution now shows sign soft he same with human mental labor.

(Figure 1)



Many traditional methods are being replaced by digital alternatives; data gathering, processing, and storage through silicon-based methods have increasingly become then or min society. With the increase in computational power and capabilities, the twenty-first century has seen incredible development in the field of Artificial Intelligence (A.I.).

It has been applied successfully in fields ranging from e-commerce and human resource management to self-driving automobiles and targeted advertising. 2This new technology exhibits a high-level understanding of the problem and improves within creasing data and time.

Artificial neural networks are useful for mimicking empirical knowledge because they estimate complex nonlinear relationships between input variables and output values. 1 While this takes years of experience for an individual human the difference is that an artificial neural network can learn this process at a much faster rate.

2. ORTHODONTICS

Orthodontics and dento-facial orthopedics is a specialty that deals with several variables in each step; from Diagnosis to treatment planning, the real ways seem to be multiple correct ways of approaching

the same problem. Personal experience and adherence to evidence-based orthodontics guides the orthodontist towards the best method for each type of problem but differences of opinions between practitioners still prevail.
Objective answers to complex problems seem to be extremely are in the field of Orthodontics. The advent and development of A.I. and Machine learning-based systems are beginning to shift the paradigm. Ranging from diagnostic procedures, treatment modality success prediction, and objective treatment plan suggestion A.I. show significant promise in helping the clinician arrive at a decision.

3. IRRATIONAL FEAR OR VALID CONCERNS

A.I. is well-suited to handle repetitive work processes, managing large amount so data, and can provide another layer of decision support to mitigate errors. Experts predict A.I. to have a significant impact in diverse areas of health care such as chronic disease management and clinical decision making3 estimating that A.I. has the potential to improve patient outcomes up to 40% while halving the treatment cost.4

A.I. algorithms are showing promise in specializations such ophthalmology, cardiology, radiology, pathology, and Orthodontics.5.6 although this newer a of A.I.-augmented practice has an equal number of skeptics as proponents. The increased utilization of technology has reduced the number of job opportunities, which many doctors in them a king and practicing doctors are concerned about. These concerns seem misguided as it prioritizes the economic and social well-being of the doctor before the patient. These arguments also seem to be invalid as increased A.I. usage in medicine not only reduces manual labor and frees up the primary care physician's time but also increases productivity, precision, and efficacy there by helping the doctor, not replacing them.

A.I. systems learn more with each successive case and can be exposed to multiple cases within fractions of what it would take a clinician. A.I.-based decision-making approaches being used in situations where experts often disagree, such as identifying pulmonary tuber culos is on chest radio graphs and orthodontic treatment planning are situations where experts often disagree, being a valuable tool to serve as additional data.

A valid limitation of A.I. bases systems is that despite being able to translate human behavior analytically and logically certain human traits such as critical thinking, interpersonal and communication skills, emotional intelligence, and creativity cannot be replicated successfully currently. Another important limitation is the data that is fed to the algorithm as it can only get as good as the data set allow sit to be. Therefore, algorithms given sub-standard data cannot be expected to match the human gold-standard.

4. CLEAR ALIGNERS: MACHINE LEARNING TO PLAN TOOTH MOVEMENT

The use of AI assisted orthodontics is not a futuristic concept anymore; it is the reality of the present day. Several clear aligner companies boast about using advanced algorithms to plan out the desired tooth movements, claiming to save time of the orthodontist and patient. They keep the specifics of their technologies to themselves only allowing for the clinical findings to be examined. Thus, it is a matter of contention as to where the AI based algorithms end and where the elaborate marketing strategies begin.

Irrespective of the controversies, AI has proven itself to be in an invaluable tool in the arsenal of the orthodontist to make a decision with regard to movement of teeth. For example, the clinician simply inputs the desired location of the tooth or group of teeth which is then processed through neural networks to output the pl Artificial neural networked tooth movement. This is a departure from the traditional methods requiring high precision and skill on part of the orthodontist. The AI helps dentists in training and can provide clear objective methods.It would be unwise to ignore the several limitations of machine learning in contemporary aligner treatment.

As of today, AI based techniques ignore the presence of oral diseases, medical history, dental history, and psychological profile of the patient.7-12 This problem extends to clear aligner therapy and fixed appliance therapy. It is common to see that patient suffering from pathological tooth migration as a sequalae of periodontitis wish to get their teeth aligned.13,14 The orthodontist can make an informed and holistic treatment plan accounting for the periodontal status of the individual, but the AI will simply formulate the biomechanical treatment plan.

Mostly the orthodontic treatment is commenced after essential periodontic, endodontic, restorative etc. treatments. Because of this, using AI technology for so-called "do-it-yourself orthodontics" is highly risky. Aligners have been sold to patients without sufficient dental supervision in a number of nations. In the general population, this has resulted in several reports of tooth mutilation and bone loss. However, there is a discrepancy between professional reports on public health harms presented at conferences and studies on similar issues published in scholarly journals. Furthermore, there is some subconscious pressure and concern in the clinical and scientific community about the prospect of legally retaliating if the damage caused by these supposed fixes is exposed. Companies have financial capabilities for legal battles that much exceed those of clinicians and, in certain situations, even the largest orthodontic societies.

Another drawback of today's AI algorithms is that they don't consider the facial analysis, proportions, and aesthetics of patients.15-17 Orthodontic dental movements and face aesthetics have a direct relationship. Because tooth movement in any directionis usually linked with facial and smile aesthetics18, these assessments can only be performed by a skilled orthodontist. Furthermore, facial examination is the initial step in assessing whether dentofacial abnormalities exist and, if so, whether surgical orthodontic repairs are possible.19

When tooth movement is done, AI employed in modern planning ignores the influence of functional issues and the stability – or lack thereof – of the final tooth position. Aligners, for example, can be used to treat issues having a significant functional origin, such as the open bite malocclusion. AI, on the other hand, is currently unable to diagnose the cause of the problem or predict precise retention measures.

Machine learning models require the machine to be trained to recognize the benchmark, such as outstanding treatment outcomes. Companies use cases that have already been addressed to supply their databases with successful references, which is a crucial point in AI algorithms for aligners. Furthermore, most – if not all – aligner businesses offer equipment for non-orthodontic specialists; it is well known that non-specialists struggle to organize and execute treatments flawlessly. As a result, the company samples are skewed because the reference treatments are – for the most part – of questionable quality. The logical conclusion is that the algorithms are skewed by poor treatment outcomes and must be significantly improved before they can meaningfully assist orthodontists in achieving excellent outcomes.

Furthermore, many orthodontic tools are not successfully incorporated into AI algorithms, restricting treatment options and methods such as skeletal anchorage, teeth extractions, and integrated restorative operations. This is due to the mechanical limits of aligners in controlling specific tooth movements, at least in part. Nearly a century ago, when the fixed orthodontic appliance was invented, we had doctor-centered treatments rather than patient-centered ones. In other words, the ease and efficiency of the treatment from a mechanical standpoint was given greater weight than the comfort and effectiveness of the treatment for patients. Most treatment options and armamentarium like brackets, wires and other attachments were designed with the clinician in mind.

To improve the user experience, however, orthodontic treatment and appliances must be patient centered.20This is one of the most difficult problems in modern orthodontics, because if the traditional bracket device isn't acceptable for cosmetic and comfort reasons, the aligners will be inadequate owing to mechanical constraints. As a result, achieving a device design that addresses all these characteristics will require a significant amount of effort.

4.1. Orthogenetic surgery

A.I. has been used for improving or augmenting diagnostic, treatment planning, CAD CAM, and follow-up procedures in the field of Orthognathic surgery. AI-based intraoral scanners improve the efficiency of acquisition & A.I-assisted radiology reduces the noise and yields higher quality results with lower radiation levels.21 Various software employing ML are used to study the orofacial complex, predict outcomes, and create models. They also allow the superimposition of different inputs to give a more complete image.22

Hyuk-Il Choi et al (2019) developed a new A.I. model for the decision of surgery or non-surgery and determination of extraction.The input values for theartificial neural networkwere obtained from the lateral cephalogram as 12 variables and 6 additional indexes. In this study, 204 cases were selected for learning purposes whereas 112 cases were tested for model evaluation. The test set did not participate in model construction. The best performing models were selected and used to test the program. The diagnosis obtained through A.I. model was compared with the actual diagnosis and the decision-making process was evaluated for its success rate of surgery, non-surgery, type of surgery, and extraction or non-extraction.

As a result, the success rate of A.I. was summarized as follows:

- Diagnosing surgery vs non-surgery: 96%
- Diagnosing surgical type classification Class II/ Class III: 100%
- Diagnosing success rate of extraction/non-extraction for Class II surgery: 97%
- Diagnosing success rate of extraction/non-extraction for Class III surgery: 88%

The final diagnosis success rate for:

- -learning set: 91%
- -test set: 90%

Cumulatively, total success rate for decision making with A.I. is 91 less than 5% of Class II and Class III surgery cases were misdiagnosed. It can be inferred that many skeletal Class II malocclusion cases can be treated with non-surgical camouflage treatment while it is restricted for the skeletal Class III patients. They concluded that A.I. can prove to be an important ancillary tool but will always be dependent on experienced surgeons and clinicians to provide gold-standard data.

CAD/CAM technologies brought about significant changes in the approach to orthognathic surgery. Surgical splints, splints with extraoral bone support, patient-specific osteosynthesis titanium mini plates, and surgical navigation fabricated by A.I. based CAD/CAM methods. Better visualization and prediction of post-surgical results also directly affect the patient's motivation and optimization of consent. A non-biased filter enhances the work of the maxillofacial surgeon and orthodontist by presenting the impact of the different phases of the treatment objectively. 23Moreover, use of A.I. would allow orthodontists and surgeons to deal with future clinical challenges with similar presentations in a better m artificial neural networker. Superposition of various digital images enabled through A.I. has shown to be very useful for assessing the CBCT 3D image and digital impressions together. 24 With advances in augmented reality technology we can expect to see superimposition done in real time which can help the surgeon and orthodontist to achieve results more efficiently and accurately.

4.2. Cleft Lip and Palate

A.I. based programs have also seen use in various aspects of the treatments of patients with Cleft Lip and/or Palate (CLP).

Yizhou Li et.al (2019) proposed an innovative robotic surgery assistantbased on deep learning to improve the overall effect and reduce the technical threshold of CLP repair surgery.26 Raphael Patcas et al (2019) evaluated attractiveness of treated cleft patients and non-cleft individuals by A.I. and compared the results with panel ratings given by oral surgeons, laypeople and orthodontists...27 In conclusion, the average scores were comparable in all the rating groups. Shi-Jian Zhang et al (2019) used ML for Genetic Risk Assessment of Infants with Non-syndromic Orofacial Cleft.28 They confirmed to minimize the risk of conceiving a CLP baby that Vitamin A and folic acid are essential nutritional supplements for pregnant women.

M.K. Alam at.al (2020a, b) published 2 papers; the first paper evaluated sell aturcic a bridging, anomalies & morphology, in subjects with different types of CLP, and compared them with non-CLP subjects.29They concluded that CLP subjects with Class III malocclusion and associated dental anomalies is commonly correlated with Sella turcica bridging. They also found that Sella morphometry significantly differs between CLP vs non-CLP subjects. The second paper compared the novel A.I-driven cephalometric analysis of dental characteristics among different types of CLP and non-cleftindividuals.30 They arrived at the results that compared to non-cleft individuals; CLP andthe type of CLP revealed significantly altered dental characteristics. Among different types of CLP, in different dental characteristics Bilateral CLP exhibited maximum alteration. 31Conditions which have a genetic predilection are complex in nature as they related to anumber of other genes and have many factors affecting the expression of the gene. These kinds of multi factorial and complex relations are done very successfully by A.I. driven neural networks thus cementing its need in CLP diagnosis and treatment.

4.3. Temporomandibular Joint osteoarthritis

Priscille de Dumast et.al (2018) used a trainingdataset to remotely program a deep neural networkclassifier of temporomandibular joint (TMJ) osteoarthritis createda web-based system for storage, integration and computation of biomedical data. 32 Following that B Shoukri et.al (2019) tested bio markers correlation that are associated with condylar morphology and applied A.I. to compare and analyze shape features to assess the progression of temporomandibular joint osteoarthritis.33 They found that most significant correlations were of mouth opening ranges and morphological variability at the medial and lateral condylar poles. These findings can help the orthodontist to make decisions when considering a patient with TMJ problems.

5. CONCLUSION

AI is a revolutionary paradigm shifting technology that is now being incorporated in the field of orthodontics. Experts in the field of orthodontics have bought up several valid concerns about the indiscriminate use of AI in the discipline. Orthodontists can use AI to help them determine the optimum approach to move a tooth or a group of teeth, but AI currently overlooks the prevalence of oral disorders, does not fully integrate face analysis into its algorithms, and is unable to assess the impact of functional problems in treatment.

Orthognathic surgical procedure scan see better diagnostic precision using A.I-enhanced craniofacial imagery; 3D model assisted treatment planning; CAD/CAM manufacturing of custom orthodontic /surgical appliances; image super imposition enabled improved the rapeutic follow-up due to finer interval comparison of results. A.I. shows the potential to be a versatile to olin the armamentarium of the surgeon and orthodontist while approaching various procedures of orthognathic surgery. Robotic assistant technology, Genetic risk assessment, evaluation official attractiveness and sellturcica bridging &analysis of dental characteristics in lateral cephalograms of CLP patients has been done successfully with use of A.I-based programs. Neural networks have been used to stage and classify condylar morphology in cases of TMJ osteoarthritis helping the orthodontist to make decisions when considering a patient with TMJ problems.

Responsible development of A.I. and gathering of Gold-standard data is the key to progress in the digital revolution which will enable the Orthodontist to provide the best, most efficient and stable treatment to their patients.

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