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Scientific Editorial - 3D Printing In dentistry – from crowns to braces – New era of dentistry

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3D printing is hailed as one of ultimate technologies that may disrupt the established practices in dentistry. Dentistry is one of its kinds of the spheres of medical profession who have been into making of artistic replacements of teeth to accessories in dental treatment since time immemorial. The dental technician, the technology – all have played an important role in the way we practice the profession today. Dentistry has been using tools to manufacture and always has moved with time in incorporating technology in day to day practice. CAD CAM is perhaps used more in dentistry than any other field of medicine. With the advent of digital impressions like 3SHAPE , we the dental surgeons are equipped with the ultimate source to treat the human dentition.

Applications of 3D printing in Dentistry can be briefly classified into :

1. Prosthodontics
2. Restorative dentistry

3. Orthodontics
4. Oral and Maxillofacial Surgery
5. Dental instrumentation development

The day is not far when we will scan the tooth prep and print the prosthesis chair side. Restorations to Obturators, Appliances to Stents – the list goes on and on . The challenges may include the biocompatibility of the material used in printing and getting machines with embedded software that works with our existing infrastructure. In a recent Publication, the author tells us how powerful Prosthodontics is with advent of 3D printing.”¹ Imagine a world where you would be able to print an inlay or onlay or a crown with precision. Printing Implant surgical and prosthetic guides is already been tried by many investigators and has substantial success.²The day is not far when we will have 3D printed Brackets and wires customized to individual patients.

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Diagnostic Reasoning and Pattern recognition

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Abstract

Diagnosis is the result of complex analysis of data collected by the clinician by means of history and examination of the patient. Multiple steps are involved in data

assimilation and analysis and in this paper I have tried to bring in the concept of Pattern Recognition and how it could help in better diagnosis of Oral conditions.

Key-words: Diagnosis, Pattern Recognition

Introduction

Reasoning is to Think, understand, and form judgments by a process of logic. How we understand Diagnostic reasoning can be classified as

- SEE ONE, DO ONE, TEACH ONE ¹
 - (THE 2400- YEAR-OLD HIPPOCRATIC APPRENTICESHIP APPROACH)
- JUST READ THE FIRST 300 PAGES OF Burkitt's
 - (THE "GO-AWAY-AND-STOP-ASKING-QUESTIONS" APPROACH)
- CARRY OUT A COMPLETE HISTORY AND PHYSICAL
 - (THE "YOU-DO-WHAT-I DON'T-DO" APPROACH)

Diagnosis in its pure form is initiated because of a system malfunction & Inferences are generated from observables and inquiries about the nature

of the malfunction. The inferences yield a series of provisional approximations that are revised repeatedly in an iterative process until all findings, positive and negative, are accounted for. Inference is the fundamental process

The medical problem solving process² involves how we learn and what we learn, which can be summarized by the following points –

- Problem-solving
- Linguistics
- Cognitive Science
- Cognitive Psychology
- Computer Science
- Research On Expertise & Learning From Mentors
- Adult Learning (Continuing Dental Education)

Medical problem Solving : Insights from the medical problem solving tell us Diagnosis is Not A Rote Information-gathering Process – It involves Specific Structural Elements & can Be Expressed Unambiguously By A Language Of These Elements. And most importantly it is An Inferential Iterative Process

Linguistics : The Language and structural elements of the diagnosis include³

- Hypothesis Generation
- Context Formulation
- Hypothesis Refinement
- Probabilistic, Physiologic, And Causal Reasoning
- Differential Diagnosis
- Hypothesis Verification: Assessing For Adequacy,
- Working (Final) Diagnosis

Cognitive Science ,Cognitive Psychology & Computer Science :^{4,5,6}

The critical Importance of Knowledge is knowing that –

- Knowledge And Reasoning Are Interdependent
- Knowledge Forms The Basis Of Expertise
- But Expertise Requires Ongoing Effort And Feedback
- Should Not Underestimate Amount Of Medical Knowledge

Reasoning is a dual process – Intuitive and Analytical

Intuitive component:

- Instinctual, Rapid Responses; Effortless And Autonomous
- Require No Active Thought
- Pattern Recognition
- First Impressions, No Input From Analytic Component

Disadvantages-

- Valuable And Usually Accurate But Can Be Source Of Cognitive Errors
- Learned By Repeated Exposure And Feedback

Analytical Component :

- Deliberate, Mindful
- Not Instantaneous
- Based On Science, Causal Relations, Logic, Probabilistic Associations
- Requires Considerable Cognitive Work

Advantages:

- Less Likely To Be Error-prone
- Serves As A Check And, If Necessary, An Override On Intuitive Responses

Pattern recognition is a powerful tool which ma further ease the diagnostic process . Intuitive Pattern Recognition Is A Powerful Tool- Encourage Exposure To Images , Radiologic , Lab Findings , Which Will Further Enhance The Accuracy Of Inference.

Example of Pattern Recognition :

CLICKING TMJ SOUND	DEVIATED MOUTH OPENING
PRE AURICULAR DULL PAIN ON MASTICATION	MUSCLE TENDERNESS

-----> Myofunctional

Pain Dysfunction Syndrome

MOSTLY PRESENT WITH A TOOTH DECAY	LOCALISED SEVERE THROBBING PAIN	PAIN ON LYING DOWN
TENDER ON PERCUSSION	RADIOGRAPHIC PDL SPACE WIDENING	

----->Infers – Acute periapical

abscess

Research On Expertise & Learning From Mentors:

Experts Know More, Perceive More, Remember More .Memory (Both Short And Long Term) Is Expandable, But It Takes Work. “The Development Of Genuine Expertise Requires Struggle, Sacrifice, And Honest, Often Painful Self-assessment.

There Are No Shortcuts. ... And You Will Need To Invest That Time Wisely, By Engaging In ‘Deliberate Practice’ – Practice That Focuses On Tasks Beyond Your Current Level Of Competence And Comfort.”⁷

Adult Learning (Continuing Dental Education) :

Experience Is the Learner’s Textbook. New Knowledge Is Learned Most Effectively When In Context Of Real Life Applications.

Best Time To Learn Is When Material Is Immediately UsefulOpen Criticism And Acceptance Of Criticism

Conclusion:

Experience Shows That With Appropriate Exposure To Well-selected Clinical Material, Many Become Expert Diagnostic Problem Solvers. Though We Know Little About The Development Of Such Expertise, We Can Infer That Deliberate Exposure To Real Cases And Images, Learning The Language And The Elements Of Diagnosis And Thoughtful Mentoring Promotes Success. Thus I Propose That Learning Diagnosis Be Case-based And Coached (Mentored). Pattern recognition is the thing that we need to mentor our newer generation of dentists. This will ease and bring in more precision of diagnostic approach.

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Pictorial

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