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Smile Shimmers: Unveiling The Radiance of Orthodontic Pearls - A Review

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Abstract

Orthodontic specialists get invaluable knowledge, advice, and insights via their experiences in the area of orthodontics. These are known as orthodontic pearls. These pearls stand for the knowledge acquired while handling a range of situations with success and overcoming obstacles that may come up throughout orthodontic treatment. This review article covers every facet of the orthodontics discipline that is practically applicable when treating patients or that is very significant as a concept. The area of orthodontics is dynamic and always changing due to developments in treatment techniques and technology. Because of this, orthodontic pearls also grow and change, embracing new

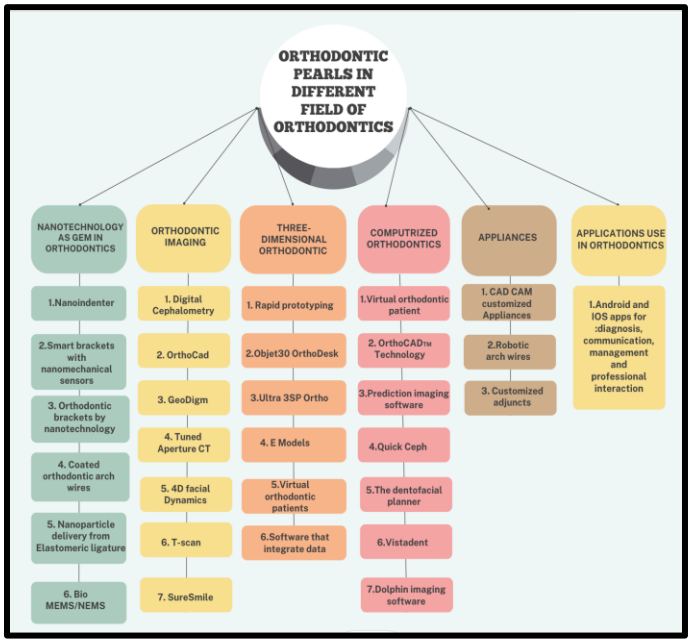
methods, tools, and evidence-based procedures. By remaining up to date and incorporating these pearls into their clinical practice, orthodontic practitioners may provide their patients with the best possible treatment and outcomes. Orthodontic pearls provide orthodontists with practical insights to traverse the intricacies of orthodontic treatment by acting as a link between theoretical knowledge and practical clinical practice. Orthodontic pearls remain a vital and dynamic component of improving patient care and the orthodontic profession as a whole, even as the field develops. A long-standing professional objective of gathering some of the best and most practical small ideas that orthodontic practitioners employ is satisfied by orthodontic pearl.

Keywords: Orthodontic pearls, Orthodontic latest technologies, Orthodontic education

Introduction

Orthodontic pearl describes a method of instruction that conveys important, useful, and condensed knowledge about orthodontics. A "pearl" in orthodontics usually refers to a small piece of information that is very insightful or helpful. This strategy might be applied to orthodontics and involve disseminating important knowledge, pointers, or strategies that are particularly helpful to orthodontic practitioners, students, or other interested parties.[1] A wide range of subjects, including treatment planning, case management, patient communication, and the application of particular orthodontic procedures or technologies, may be covered by these pearls. Important topics covered include the integration of digital technologies, good patient communication, and early intervention. By emphasising high-impact, useful knowledge that is easily used in clinical practice, Orthodontic Pearl seeks to expedite the learning process. In the orthodontic practice, where professionals are often looking for methods to improve their abilities and keep abreast of the most recent advancements in the domains, this method is frequently valued. This can be used by educational platforms, conferences, workshops, and online resources to impart insightful orthodontic knowledge to a wide range of users and encourage ongoing learning and development among the orthodontic community.[2-3]Thus, orthodontic pearls are collections of useful information that can help clinicians make better clinical decisions on a daily basis and enhance the overall outcome of orthodontic therapy.

Flow chart 1 shows the various orthodontic pearls in different field of orthodontics.



Flow Chart 1: Orthodontic Pearls in Different Field of Orthodontics

Nanotechnology as a Gem in Orthodontics

Nanoindenter

The nano scale surface characteristics of biomaterials are assessed using a nano indenter in conjunction with an atomic force microscope (afm). Additionally, they have been applied in the assessment of mechanical attributes as strain, elastic modulus, yield strength, fracture toughness, scratch hardness, and wear characteristics of

the orthodontic materials.[4]The tool is employed for topographic analysis at high resolution, yielding a three-dimensional surface profile. Image processing software can be used to show the captured data as colour or brightness values for each pixel as shown in Figure 1. Afm has been used to analyse the nanoscale dimension of the wire and orthodontic bracket, as well as the changes that occurred during the treatment and works as a orthodontic pearl and do magic in the field of orthodontics.

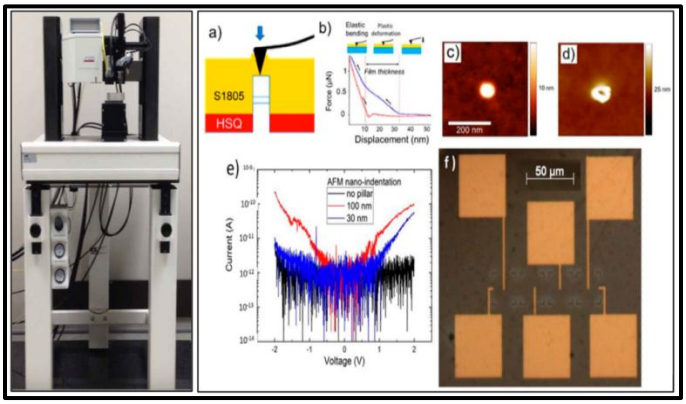


Figure 1: Atomic Force Microscopy (AFM) and Nano Indentation

Smart brackets with nanomechanical sensor

Understanding the 3D force-moment systems used in orthodontic tooth movement is crucial for both reducing the risk of traumatic side effects and predicting the trajectory of tooth movement.[5] Real-time feedback regarding the applied orthodontic forces can be obtained by fabricating and integrating nanomechanical sensors into the base of orthodontic brackets and permits the orthodontist to modify the force applied in order to bring teeth into alignment effectively and with the fewest possible negative effects and which do wonders in the field of orthodontics as shown in Figure 2.

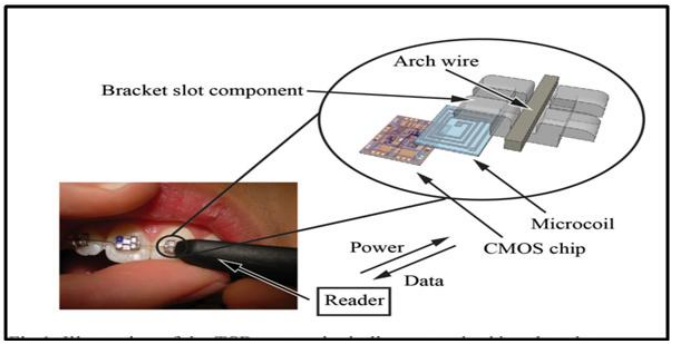


Figure 2: Smart brackets with nanomechanical sensor

Orthodontic brackets by nanotechnology

In order to create orthodontic brackets, hard aluminium nanoparticles embedded in polystyrene were introduced in 2012.The material's rigidity reduces the brackets' mechanical and frictional resistance to orthodontic wire while also enhancing their strength[6].

Coating with following also improve properties like:

- Nanoparticles of tungsten disulfide that resemble fullerene to reduce friction.
- Zinc oxide and copper oxide nanoparticles for antibacterial properties.
- Titanium dioxide improve its photocatalytic properties.

Coated orthodontic arch wires

Orthodontic treatment consists of sliding brackets along an arch wire. However, this implies that a friction force develops and the reduction of friction force would be advantageous. Friction force develops between the surfaces of the arch wire and the bracket. Enabling more control over the anchoring and mobility which decrease the duration of therapy and the chance of root resorption.[7]For many years, different strategies have been sought to find solutions to reduce friction. It was suggested that the best solution is the coating of orthodontic arch wires with a film incorporating nanoparticles. The best materials for achieving the goal of friction reduction are considered to be MOS2 (molybdenum disulfide) and WS2 (tungsten

disulfide).The inorganic fullerene-like tungsten disulfide (If-WS2) nanoparticles have been used for this purpose. The nanoparticles also develop poor reactivity, which prevent any oxidation. It is known that WS2 and MOS2 particles with layered structures provide good lubricity and is very helpful in treatment.

Nanoparticle delivery from Elastomeric ligature

Elastomeric ligatures can serve as a carrier for delivery of nanoparticles. Elastomeric ligatures deliver nano particles that can be anticariogenic(fluoride), anti-inflammatory and antibiotic drug molecules embedded in the elastomericmatrix.[8]The fluoride release from elastomeric ligatures can be of very great help and which is characterized by an initial burst of fluoride during the first few days followed by slow release. For benefit, the fluoride ties should be replaced monthly.

Orthodontic Imaging

Digital Cephalometry

With the advent of extraoral radiography, which is less expensive, and the growing use of computers in orthodontics, digitalized cephalometric imaging has lately emerged as a viable substitute. Digital cephalometry is replacing the widely utilised film-based cephalometry in orthodontics. The development of digital radiography, which has already been thoroughly discussed, is comparable to that of digital cephalograms. Liu et al. used a variety of angular and linear measures to assess the precision of computerised landmark recognition. They came to the conclusion that additional research is necessary to confirm the precision of computerised landmark identification as a result.[9]The goal of Geelen et al's study was to ascertain whether or not cephalometric landmarks could be accurately replicated on monitor pictures, standard film, and hard copies made with the storage phosphor method. They came to the conclusion that there was no clinically significant distinction between the various landmark recognition methods as shown in Figure 3. It could be challenging for physicians to choose one to employ with so many possibilities available. Thankfully, a multitude of software tools are at their disposal to assist them in making that choice. India is the birthplace of 13 cephalometric studies, as well as computerised digitising techniques like Digiceph, which was devised at the Department of Dental Surgery at All India Institute of Medical Sciences and the Centre for Bio-Medical Engineering at Indian Institutes of Technology Delhi.

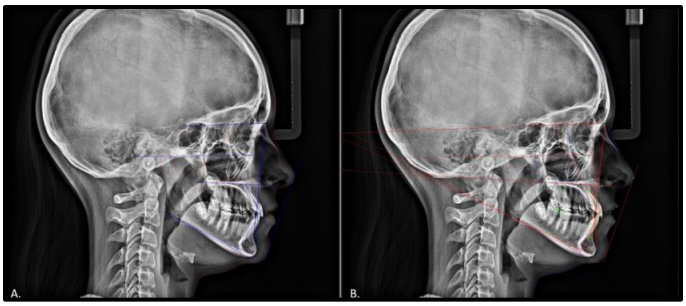


Figure3:A. Manual digital cephalometric tracing. B. Automatic digital tracing

Orthocad

The digital study model collection, evaluation, and archiving technology offered by Ortho Cad is utilised by approximately 10% of orthodontists in the United States and Canada. The developer of this programme (computer-aided dentistry) is Cadent.[10]To take an image of the model from an equivalent plaster, an optical scanner is employed. They are then displayed to the orthodontist, who may work with the models in virtual reality and collect data with various diagnostic tools utilising the patent Ortho Cad software user interface. It is necessary to have a precise bite record and excellent impressions. High-quality polyether, polyvinyl silicone, or alginate imprints are acceptable. The goal is precise and steady impressions in terms of dimensions. To clean alginate imprints, wrap them in a paper towel that has been heated, then keeping the moisture in by putting

them in a plastic bag. After impressions are sent, polyether materials can be employed for long-term storage and travel. Without destroying the original plaster counterparts, plaster counterparts of the impressions are made and optically scanned into the Ortho Cad computer system. Lastly, the computer is used to store the patient's 3D virtual representations as shown in Figure 4.

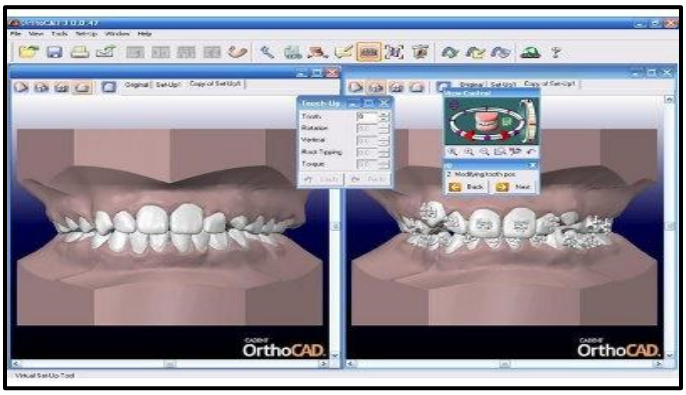


Figure 4: Orthocad Software used in orthodontics

Benefits: Data from a virtual model may be measured and stored more effectively and easily. It can also be viewed and accessed at the chair side alongside other clinical data related to the patient, including digital photos, X-rays, and clinical notes, all stored in the patient's digital file. It can be distributed by printouts or email attachments to other professionals.

T-Scan

Digital occlusal technology known as T-scan records quantifiable relative occlusal force and contact time sequencing in real-time. The T-scan system consists of a colour computer screen display with T-Scan® software, a processing unit, a USB handle, and a U-shaped HD sensor in both big and small sizes as shown in Figure 5.

Figure 5: T Scan Device

The bilateral (right-left) force distribution, the proportion of occlusal force present in the front and posterior quadrants, the occlusal contact sequence, and the individual tooth contact force percentages are all recorded and shown visually by the T-Scan® III system[11].

T-Scan's Parts:

- Sensor and support
- Handle assembly
- Computer software
- Printer

T-scan applications in orthodontics include:

- Record occlusion before treatment and monitor bite changes over time
- Identify lateral interferences
- Identify early and high forces so we can redistribute them quickly
- Verify proper occlusion, both aesthetically and functionally
- Prevent patients from developing malocclusion later in life
- Ensure long-lasting, stable results

Sure Smile

A revolutionary treatment approach has been made possible by computer administration, sophisticated 3D data processing, robots, and 3D imaging of the teeth. Patient-centered practices provide excellent care with the

least amount of discomfort, compliance requirements, chair time, and treatment completion on time. Using Sure Smile(Dentsply Sirona) as shown in Figure 6 has a number of advantages, such as a decrease in treatment errors brought on by careless appliance management, the ability to take pictures, the ability to visualise diagnostic tools in three dimensions, and enhanced patient-orthodontist communication[12].

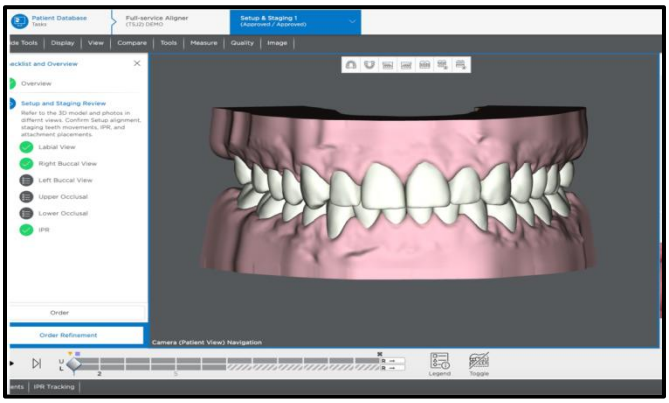


Figure 6: Sure Smile Software

Clinical procedures: Real-time, in vivo images of the patient's teeth are captured by a handheld scanner called an oro-scanner (oro matrix). Similar to an articulating spot spray, a thin white coating is placed to the teeth to prepare them for scanning. The teeth are lit with structured white light, and a precisely crafted grid is projected onto them to produce a rapid series of images. A video camera included into the scanner's grip takes pictures of the distorted grid and the reflected dentition as the portable device is moved over the teeth. To view every tooth surface, including the undercuts, the scanner is moved across the dentition in a rocking motion. Each arch takes about 112 minutes to finish. A mobile care smile cart can be used to transfer the scanner from one chair to another. The scanning stage involves sending the computer multiple, overlapping photos. Advanced approaches to data registration and management enable computer modelling and image processing. Ultimately, the teeth are compared to teeth in a dental morphology library. Microsoft Windows-based software allows for the creation of a diagnosis, treatment plan, and outcome simulation. Unwanted tooth movement may be reduced to a minimum, and mistakes in arch-wire selection may be avoided if at all possible.

Three Dimensional Orthodontics

Rapid prototyping

The creation of a three-dimensional (3D) model from a computer-aided design (CAD) is known as rapid prototyping (RP), and it is often done layer by layer in accordance with the 3D input. A company named 3D systems, Inc. introduced the first commercial RP method at the Auto fact show in Detroit, Michigan, in November 1987.This technique, known as "layered manufacturing" or "solid free form fabrication," works by first developing a solid 3D CAD model of an object, which is subsequently broken down into cross-sectional layers and numerical files in the form of virtual trajectories.[13]It directs the physicaly quick assembly of those layers using material additive processes in an automated fabrication machine to create the product known as the prototype.

Rapid Prototyping types:

1. Stereo lithography
2. Fused deposition modeling
3. Selective laser melting and selective lasersintering
4. Inkjet printing
5. Electron beam melting (EBM)
6. Digital Light Processing (DLP)
7. Laminated object manufacturing (LOM)

Stereolithography

While several other models are already available, 3D Systems remains the major producer of SLA printers. A concentrated UV laser light can cure liquid resin, which is submerged in the build tray of a SLA printer as shown in Figure 7. Each layer is formed by the laser drawing a

cross-section of the item. Uncured resin can cover the previous layer when the tray drops by the thickness of the layer after it has cured[13]. As the printed object acquires shape, hundreds of repetitions of this process are made. Because the laser can only cure a limited area at a time, SLA printers are typically slower than other types.

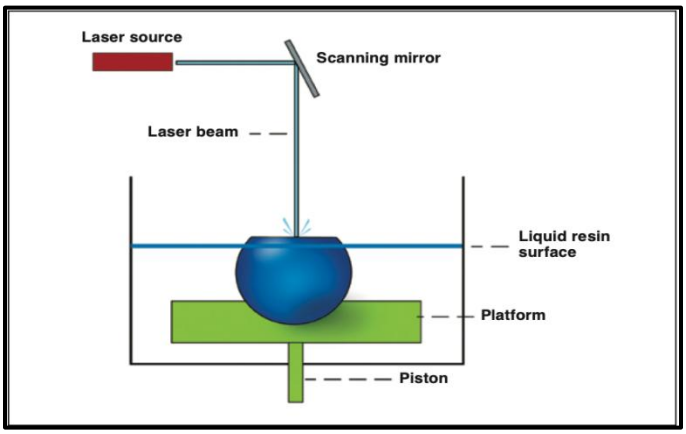


Figure 7:Stereolithography (SLA) printer.

Objet 30 Ortho Desk

A new version of the Stratasys Objet 30 printer, the Objet30 Ortho Desk TM, was created as a more compact and reasonably priced Poly Jet printer for home and small-business application. In orthodontic models, the Objet30 can create layers as thin as 28 microns. Excellent surface quality orthodontic models can be produced with the Objet30. Three materials are available: MED610, a clear, biocompatible material commonly used for surgical guides and medically approved for short-term intraoral applications of up to 24 hours; Vero Dent Plus TM (MED690), a peach-colored acrylic-based polymer used for most appliances; and Vero Glaze TM (MED620), an acrylic used for veneer models or wax-ups in colour A2 that can also be used in the mouth for 24 hours[14].With the Ortho Desk's build area measuring 300 x 200 x 100 mm, up to 12 horseshoe-shaped objects can be created in a single job.

Virtual orthodontic patient

It is feasible to create a virtual orthodontic patient in which the bone, tissue, and teeth can all be seen in three dimensions by using 3D imaging and 4D facial dynamics. Numerous soft and hard tissue tests as well as a large amount of data collection will be made possible by the notion of the virtual orthodontic patient.[15]We will learn more about the masticatory system and get a better grasp of the biomechanics of tooth movement as well as orthopaedic and orthognathic adjustments.

Prediction imaging software

One can use one of the many available prediction software programmes, either by itself or in conjunction with video pictures, to forecast the results of orthognathic surgery[16].Currently, a number of software programmes are available that let medical professionals work with digital tracings of the hard and soft tissues, then alter the pretreatment image to create a therapy simulation.

Quick Ceph

It was the first orthognathic surgery prediction programme to be made accessible for purchase. Based on a 28-point digitization, it allows for a broad range of functions. The computer records changes in both horizontal and vertical directions during the simulation of orthodontic and surgical movements[17]. Soft tissue is automatically adjusted in accordance with preset ratios. Many features were added to its most recent version, QuickCeph2000, such as the ability to record and store high-resolution photographs, treat simulations, growth projections, and compatibility with all operating systems. It also improved the accuracy of tracing images digitally.

The dentofacial planner

The cephalometric analyses that may be performed using the dentofacial planner created by Dentofacial Software Inc. (Toronto, Canada) include Steiner, Downs,

McNamara, Ricketts, Grummons, Harvold, Legan, and Jarabak.[18] Additionally, it can simulate any combination of orthognathic surgical operations, such as one piece or segmental maxillary surgery, mandibular advancement or setback, complete or anterior mandibular sub apical surgery, and chin surgery. It can even execute CO–CR conversions.

Vistadent

Another orthognathic surgery programme that uses VTO (Ricketts) for treatment simulations is Vistadent (GAC International, Birmingham, AL), created by GAC Techno Center. All digital cameras and X-ray systems are compatible with it. Ortho-vision technologies distributes the surgery prediction tool known as Orthodontic Treatment Planner (OTP) from Pacific Coast Software, Inc. in Wayzata.[19]

Dolphin Imaging Software

Currently commercially available, Dolphin Imaging Software (Dolphin Imaging and Management Solutions,) is a well-liked orthognathic surgical programme. Through the use of a mouse-controlled cursor, the software indirectly digitises the bone, soft tissue, and dental landmarks of the scanned cephalogram.[20]The points are connected by the programme to create a trace image, which can be manually adjusted for a better fit. After that, the user can choose their preferred analysis.

Applications Use in Orthodontics

Android and iOS apps for diagnosis,communication,management and professionalinteraction

In orthodontics, software applications, or Apps, are also made. Numerous applications for iOS and Android have been developed to facilitate diagnosis, treatment planning, communication, and patient contact[21]. The applications include practice management apps for clinicians, patient apps like as progress trackers, diagnostic apps, and patient reminder apps, as well as public awareness information and orthodontic educational apps such as model analysis apps and peer-reviewed journals.Various examples of Applications used inOrthodontics are shown in TABLE I.

Table 1: Android and iOS applications used in Orthodontics

CLINICIAN APPS	PATIENT APPS	EDUCATIONAL APPS
Orthodontic Update (provides access to the publications)	Brace Mate (provides emergency information to follow if there is any problem, patients can pick colors of the modules they wanted for their teeth)	Glossary of Orthodontic Terms (dictionary app for students to clear concepts of all the terms used in orthodontics)
Doctor Smile Orthodontics (for giving patients education and motivation)	Brace Reminder (notification reminder for tightening)	AJODO (abstracts of articles can be read)
Dolphin My Orthodontist (helps to connect with the patients, appointments, account balances, and media for patient education can be managed)	My Orthodontist (provides information about orthodontists, FAQs, office hours, and directions)	One Ceph (for cephalometric analysis)
Dental Monitoring (allows remote monitoring of a patient and educates the patient to take good pictures of the teeth	Orthodontic Guide (provides information about orthodontic specialty and treatment options	I Model Analysis (for study model analysis)
REM Orthodontics (for shopping for orthodontic materials)	Tray minder Aligner Tracker (helps the patient to track aligner wear time on each day, shows a reminder to switch to the next aligner, and takes teeth selfies to document progress)	Interceptive Orthodontics (provides step by step guide to early intervention in cases of ectopic eruption of maxillary canines and molars)

Conclusion

The insights shared in this article underscore the importance of pearls in orthodontics. By integrating these into clinical practice, orthodontists can enhance patient outcomes, streamline treatment processes, and address common challenges more effectively. As the field of orthodontics continues to evolve, staying abreast of such practical pearls will be crucial in delivering optimal care. Future research and clinical experiences will undoubtedly provide further refinements, allowing practitioners to continually elevate their practice. Embracing these pearls not only aids in achieving better

results but also reinforces the commitment to excellence in orthodontic care.

References

1. Mizrahi, E. (Ed.). (2015). Orthodontic Pearls: A Selection of Practical Tips and Clinical Expertise, Second Edition (2nd ed.).
2. Van Harrison R. Systems-based framework for continuing medical education and improvements in translating new knowledge into physicians' practices. J ContinEduc Health Prof. 2004;24(Suppl 1):S50–62.
3. Shah UH, Singla A, Mahajan V, Jaj HS, Dhiman I, Thakur S. Comparison of Slot Deformation in Different Types of Bracket During Torque Application—A Finite Element Study. Journal of Indian Orthodontic Society. 2023;0(0).
4. Alcock, J., Ireland, A. J., Sandy, J. R., & Barbour, M. E. (2007). Nanoindentation of orthodontic archwires: variation of elastic modulus and hardness within a stainless steel wire. International Journal of Nano and Biomaterials, 1(2), 128.
5. Lapatki BG, Paul O. Smart brackets for 3D-force-moment measurements in orthodontic research and therapy-developmental status and prospects. J OrofacOrthop. 2007 Sep;68(5):377-96.
6. Zakrzewski, W, Dobrzynski M, Dobrzynski W, Zawadzka-Knefel A , Janecki M, Kurek K, Wiglusz R. J (2021). Nanomaterials Application in Orthodontics. Nanomaterials, 11(2), 337.
7. Syed SS, Kulkarni D, Todkar R, Bagul RS, Parekh K, Bhujbal N. A novel method of coating orthodontic archwires with nanoparticles. J Int Oral Health. 2015 May;7(5):30-3.
8. De Stefani A, Bruno G, Preo G, Gracco A. Application of Nanotechnology in Orthodontic Materials: A State-of-the-Art Review. Dent J (Basel). 2020 Nov 9;8(4):126.
9. Baxi S, Shadani K, Kesri R, Ukey A, Joshi C, Hardiya H. Recent Advanced Diagnostic Aids in Orthodontics. Cureus. 2022 Nov 26;14(11):e31921.
10. Joffe L. OrthoCAD: digital models for a digital era. J Orthod. 2004 Dec;31(4):344-7.
11. Qadeer S, Yang L, Sarinnaphakorn L, Kerstein RB. Comparison of closure occlusal force parameters in post-orthodontic and non-orthodontic subjects using T-Scan® III DMD occlusal analysis. Cranio. 2016 Nov;34(6):395-401.
12. Mah, J., &Sachdeva, R. (2001). Computer-assisted orthodontic treatment: The SureSmile process. American Journal of Orthodontics and Dentofacial Orthopedics, 120(1), 85–87.
13. Kumar A,Ghafoor H. Rapid prototyping: A future in orthodontics.J Orthod Res2016;4 1-7.
14. Groth C, Kravitz ND, Jones PE, Graham JW, Redmond WR. Three-dimensional printing technology. J Clin Orthod. 2014 Aug;48(8):475-85.
15. Hajeer MY, Millett DT, Ayoub AF, Siebert JP .Current Products andPractices.Applications of 3D imaging in orthodontics:Part II .Journal of Orthodontics, Vol. 31,2004, 154–16.
16. Kolokitha O, Topouzelis N. CephalometricMethods of Prediction in Orthognathic Surgery. Journal of Maxillofacial and Oral Surgery. 2011;10(3):236-245.
17. Kaipatur N, Al-Thomali Y, Flores-Mir C. Accuracy of computer programs in predictingorthognathic surgery hard tissue response. J Oral Maxillofac Surg. 2009; 67:1628–1639.
18. Seeholzer H, Walker R. Orthodontic and oral surgical treatment planning by computer, for

example, the dentofacial planners (II).Quintessenz. 1991; 2:257–262.

19. Birla S, Mathur A, Thakur A, Toshniwal NG. Preplanning Contemporary Incisor Positioning using Inclinometer: A Clinical and Cephalometric Study. J Ind Orthod Soc 2014;48(4):217-223.
20. Power G, Breckon J, Sherriff M, McDonald F. Dolphin imaging software: An analysis ofthe accuracy of cephalometric digitization and orthognathic prediction. Int J Oral MaxillofacSurg. 2005; 34:619–626.
21. Vaid NR. Up in the Air: Orthodontic technology unplugged!. APOS Trends Orthod 2017;7:1- 5.