

interview

BJÖRN
Ludwig¹



- a) Mark **WERTHEIMER**²
 b) Oyku **DALCI**³
 c) Didem **NALBANTGIL**⁴
 d) Joseph **BOUSERHAL**⁵
 e) Jorge **FABER**⁶



1. Private orthodontic practice in Traben-Trarbach, Germany. Assistant Professor at the University of Homburg/Saar, Department of Orthodontics. Editor-in-chief of the Quintessenz publication "Kieferorthopädie" (Orthodontics). Co-editor of the Journal of Clinical Orthodontics. Serves in the council of the German Board of Orthodontics. Past president of the European Begg Society. Orcid: 0000-0002-5910-9137
2. BDS, MSc(Dent), MDent(Orth), FCD(SA)Orth, FICD. Past president and Honorary Life Member of the South African Society of Orthodontists. Best reviewer APDS Journal, 2016. Member of AAO International Ambassadors Forum. Secretary of College of Dentistry of South Africa. Orcid: 0000-0003-2547-4117
3. DDS (Turkey), PhD and Spec Orthod (Turkey). Currently Senior Lecturer and Orthodontic Course Coordinator at the University of Sydney, School of Dentistry, Discipline of Orthodontics and Paediatric Dentistry, Sydney, Australia. Orcid: 0000-0003-3005-829X
4. Associate Professor, Yeditepe University, Istanbul (Turkey). Currently, Head of Department, Faculty of Dentistry. Member of the Board of Directors. Assistant Director of Health Sciences Institute. Orcid: 0000-0003-4432-6072
5. Professor of Orthodontics, Saint Joseph University of Beirut, Lebanon. Research Lab Director, Saint Joseph University of Beirut, Lebanon. Adjunct Clinical Professor, Boston University, USA. Member, Angle Society of Orthodontists, East Component, USA. Member, Tweed Foundation for Orthodontic Education and Research, USA. Executive Committee Member, World Federation of Orthodontists. Orcid: 0000-0001-6675-9261
6. Emeritus Editor of the Dental Press Journal of Orthodontics and former editor-in-chief of the Journal of the World Federation of Orthodontists. Researcher and professor at the Graduate Program in Dentistry at the University of Brasília, Brazil. Certified by the Brazilian Board of Orthodontics. Orcid: 0000-0003-0564-406X

Contemporary orthodontics has been heavily influenced by German enthusiasts who have aligned the tradition of German engineering and technology with the art and science of treating patients. This combination culminated in a series of innovations that have allowed better and more user-friendly treatment options for the population. Dr. Björn Ludwig is one of those enthusiasts. He has worked on important fields that are at the frontier of knowledge and that mark the specialty at the beginning of the 20th century — CAD/CAM designed appliances, the impact of orthodontic treatment on sleep apnea, and 3D imaging are some of these fields. By reading this interview, readers are invited to look at the astrolabe and the compass, providing, respectively, our present location in the evolutionary path of our specialty, and the direction we are moving to.

Jorge Faber (interview coordinator)

1) What would you term hi-tech orthodontics? How has it affected your practice and what are the cost implications? (Mark Wertheimer and Jorge Faber)

Wikipedia says high tech is technology that is at the cutting edge: the most advanced technology available. The opposite of high-tech is low technology, referring to simple, often traditional or mechanical technology. In orthodontics we need to categorize high- and low-tech for products, diagnostics and treatment. These categories may refer in general to products or manufacturing processes, but this terminology can be misleading concerning orthodontics and seem often abused, especially in social media. Certainly, claims of utilizing hi-tech products in practice doesn't ensure that the doctor provides excellent orthodontic care or treatment and such claims in advertising may be considered unethical in some environs. To follow are some typical categories where the term, "hi-tech" has been used as a descriptor.

Orthodontic products

- » Some brackets or wires that may be considered to have been fabricated at a higher quality or considered to be more precisely manufactured.
- » Some designs of orthodontic products may be clinically better than others (e.g., greater shear bond strength or a lower tolerance in manufacturing bracket slots, etc.), factors that might be clinically relevant.

Diagnostic tools

- » 2D versus 3D X-rays.
- » Alginate impression versus intraoral scanning.

Treatment

- » We can use high-tech diagnostic tools and products to treat patients; but treatment planning, biomechanics and, especially, individual decisions need to be based on evidence, as well as time-tested and established orthodontic principles, and certainly respecting the biological limitations.
- » Another aspect that should be considered more frequently is ethics. As an example, just because mini-implants are useful in some situations does not mean we should over-use them. In many cases, "low-tech" alternatives may, in fact, result in better treatment, being more economical and possibly more predictable. In this respect, the orthodontist should consider frugal innovations: "*frugal innovation is the process of reducing the complexity and cost[...] usually this refers to removing nonessential features[...] such services and products do not need to be of inferior quality but must be provided cheaply* (Wikipedia)".
- » An orthodontic example of frugal science might be the selection of extraction protocols (e.g. serial extractions) versus employing skeletal anchorage devices or expansion with high-tech self-ligating brackets.

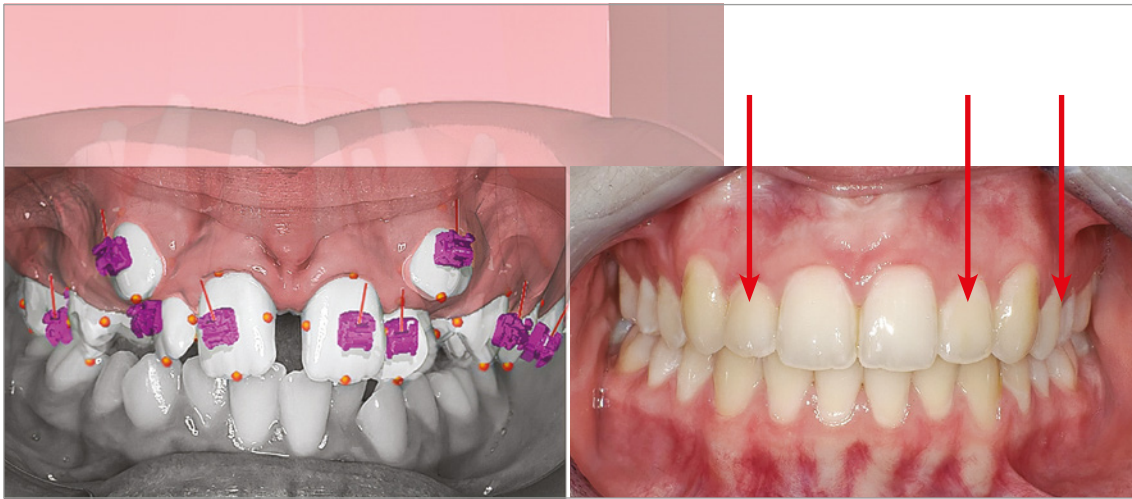


Figure 1: 3D virtual bracket positioning that resulted in favorable vertical positioning.

A clinical example in my orthodontic practice is the common use of indirect bonding^{1,2}. The bracket positions and the wire shape are digitally planned, and the bonding trays are 3D-printed. Figure 1 depicts a typical result with favorable vertical bracket positioning with intended torque, angulation, etc., that look similar to results also achievable using conventional bonding techniques.

I am personally very much attracted to high-tech products, but our treatment needs to be patient-centered and ethical. Since a massive high-tech wave hit us about 15 years ago, we have also been increasingly cognizant of providing very classical, as well as frugal, low-tech treatment protocols to reach excellent treatment results.

In short: We extract a few more teeth and use fewer mini-implants. Something I learned: 3D and high-tech does not treat patients. Orthodontists do.

2) Have 3D diagnostic protocols led you to change treatment plans, compared with what they might have been if you had not been using 3D diagnostic tools? How do you think the current 3D digital gadgets and techniques will impact on everyday orthodontic decisions? (Mark Wertheimer and Didem Nalbantgil)

3D diagnostic protocols did not lead to a fundamental change in our treatment decisions. But in highly sophisticated cases, we felt more confident in using well-known, but rarely applied, orthodontic techniques. In other words, 3D technology provides diagnostic information that allows us to implement ideas we have had for many years, but we felt they were not applicable in routine treatments, due to time and economic constraints. Following, are some retention and surgical examples:

1. Combining 3D retainer diagnostics and well-evaluated retainer material

As far as the upper jaw is concerned, it is sometimes difficult to decide if a bonded retainer is suitable both in terms of bonding and in terms

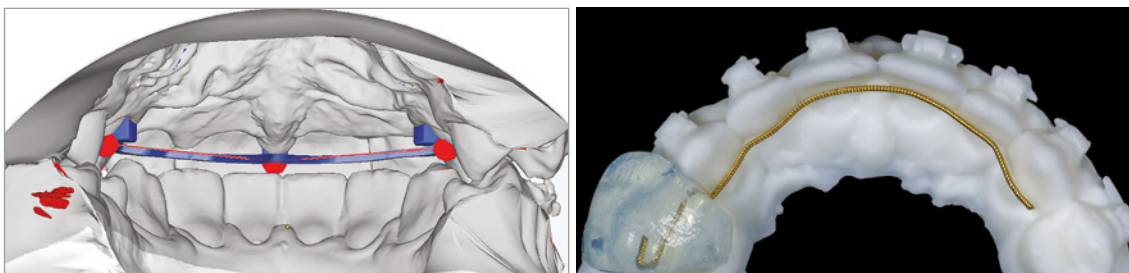


Figure 2: Hybrid retainer: Combining 3D retainer diagnostics and well-evaluated retainer material.

of function. Today, we take a quick intraoral scan and design the retainer “chair-side”, in a virtual set-up, to more carefully evaluate the situation in three dimensions. In this manner, we determine whether bonding an upper fixed retainer would be applicable. In addition, I can better illustrate to the patient why I recommend (in some situations) that we may yet need to continue treatment to establish a better overbite and overjet. Finally, we will print a model with some “vertical stops” at the virtually designed position for the retainer, with appropriate clearance. Then my technician manufactures the “classical” Zachrisson wire³.

2. Digitally designed “vacuum-formed retainers” with occlusal adjustments

Vacuum formed retainers are very popular because they are effective and economical. They could be improved—in cases with functional problems—by adding a functionally adjusted occlusal surface. Doing this the analogue way is quite challenging (i.e., time, articulator, etc.), compared to doing it digitally (virtual design and 3D print).

3. “Metal-printed” Class II retention device

In a few Class II treatments, the results may be somewhat unstable. This can happen after bi-maxillary surgery, functional appliances,



Figure 3: Digitally designed “vacuum-formed retainers” with occlusal adjustments.

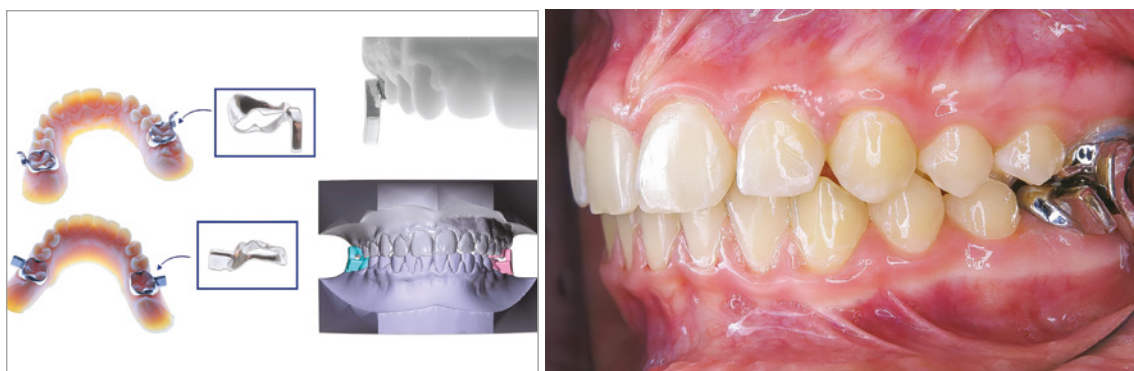


Figure 4: "Metal-printed" Class II retention device.

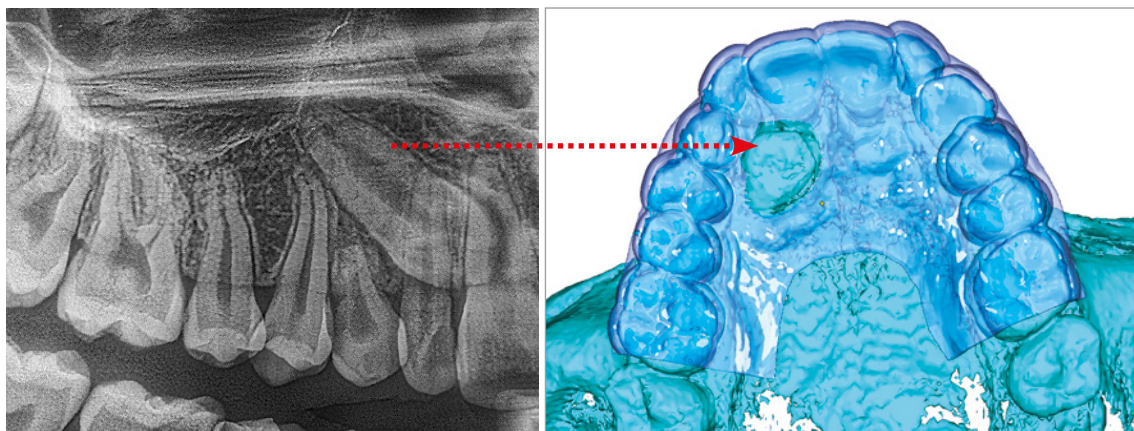


Figure 5: 2D to 3D canine exposure guide.

extraction treatment or accompanying TMJ treatment. In these situations, I most commonly use removable functionals to maintain the sagittal position, despite all the inherent limitations of removable appliances. We also use SLS metal printing to create virtually bonded Class II jigs (they appear similar to a MARA, Mandibular Anterior Repositioning Appliance). Their small size is very much appreciated by the patients.

4. 2D to 3D canine exposure guide

Patients with displaced or impacted canines are frequently treated in an orthodontic office. We create an exposure guide so that a canine is quickly localized during surgery, and other structures are protected.

5. 3D navigated tooth transplantation

Tooth transplantations are well evaluated and the success is predictable, if your surgical skills

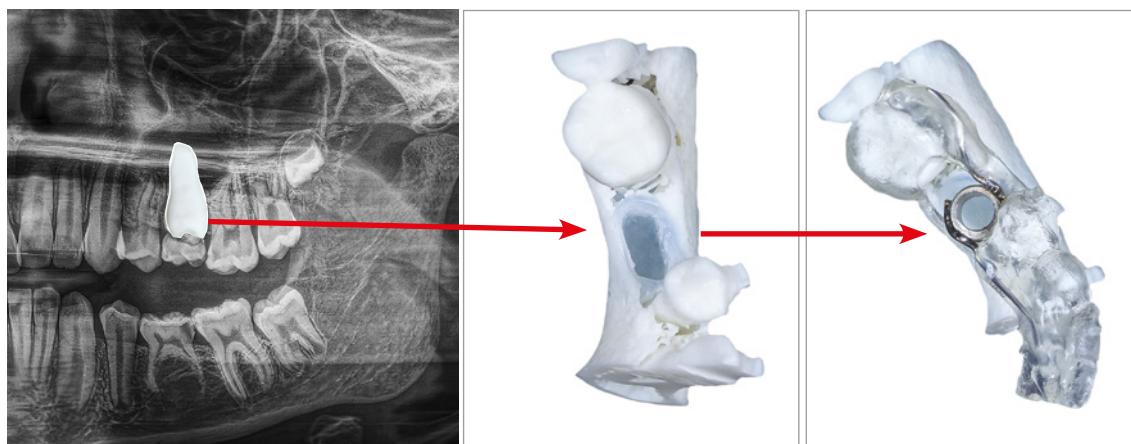


Figure 6: 3D navigated tooth transplantation.

are good. To support my surgical skills, I use donor tooth replicas and root-shaped drill guides, which make tooth transplantation predictable even for orthodontists who are surgically less skilled.

3) For which patients would you recommend using the hybrid tooth-bone-borne expanders, and for whom would you suggest pure bone-borne? What are the benefits and possible complications arising from both? (Oyku Dalci and Jorge Faber)

A two-mini-implant-retained expander (fully bone-borne) is used in cases that require only maxillary expansion. The hybrid-Hyrax RME (tooth-bone-borne) is used in cases where the molars need additional anchorage support. Such a situation is shown in Figure 7: In this Class III patient, the maxilla needed skeletal expansion. Additional Class III elastics are used along with mandibular cantilever arms to dislize the lower molars.

The greatest advantage of pure skeletal expansion is that these devices have no dental side effects. The greatest risk/complication with these appliances

is that the bone and sutures of the midface are too mature to permit expansion. Establishing more valid diagnostic protocols to evaluate whether and when SARPE (Surgically Assisted Rapid Palatal Expansion) is needed, instead of MARPE (Mini-crew-assisted rapid palatal expander), should be an important research focus in orthodontics⁴.

4) With respect to expansion with mini-implants, do you believe that it's necessary to use four screws, as advocated by some, or can the same expansion be achieved with a more simplified approach, using fewer TADs (Temporary anchorage devices)? Why? (Mark Wertheimer)

Case studies have demonstrated that 2, 4 and 6 mini-implant expanders work and yet, there has been no consensus as to how many mini-implants are necessary. At least in Caucasian patients, the average anatomy of the maxilla has been well-defined in CBCT imaging surveys. For instance, in the posterior region of the maxilla, next to the suture, the bone is "paper-thin" and the anchorage quality of screws placed there (in 4- or 6-screw expanders) might be questionable⁵ (Fig. 8).



Figure 7: Hybrid-RME and “mini” RME.

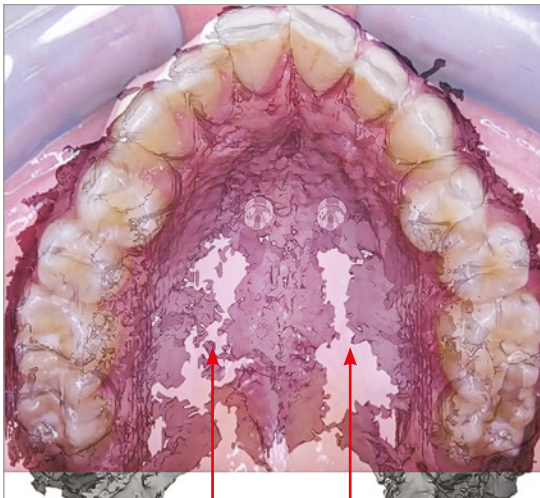


Figure 8: Typical Caucasian maxillary anatomy.

In my opinion, a defining orthodontic principal is: Diagnostics FIRST! It seems a lot of effort has been put into the development of different screw-supported expanders to “stretch the limits of expansion” in adults without SARPE, but without a focus on the quality of bone involved I think it would be more logical to do further research on protocols to evaluate, with greater predictability, the midface structures⁶.

5) Absolute anchorage has pushed the limits of orthodontic treatment. There are mainly two systems: skeletal miniplates and mini-implants. Nowadays, do you think that mini-implants can resolve all clinical issues and totally replace skeletal miniplates? If not, in which situations you see a contrasting advantage of one technique over the other? (Joseph Bouserhal)

Skeletal anchorage is used in cases in which predictable and stable maximum anchorage is needed. Considering this, the greatest risk factor when expecting any kind of skeletal change is the failure of the bony anchorage. It is also important to understand that mini-implants do not provide “absolute” anchorage. That is a falsehood, as mini-implants do “move” — they can “tip” and anchorage loss can accompany that change in position.

Different studies have determined that extra-radicular mini-implants (i.e., not between the roots) are significantly more successful than those placed between roots⁷. As a result of those findings, we only use palatal mini-implants in the maxilla and only miniplates in the mandible. These miniplates are primarily digitally designed, as shown in Figure 9.



Figure 9: CBCT-based miniplate adaptation.

6) Over the years, have you significantly changed the way you use TADs as a result of things you have learned through experience? (Mark Wertheimer)

1. I use fewer TADs and spend more time on treatment planning; mostly using quite traditional methods.

2. I have also limited the number of mini-implant insertion sites:

- a. Maxilla: palate only.
- b. Mandible: miniplates only (mostly in the chin region).

3. I insert most of the TADs simultaneously with the orthodontic appliance. This has been made possible through prospective, virtual planning of the insertion site, a TAD guide), and we use digitally designed bone-borne appliances.

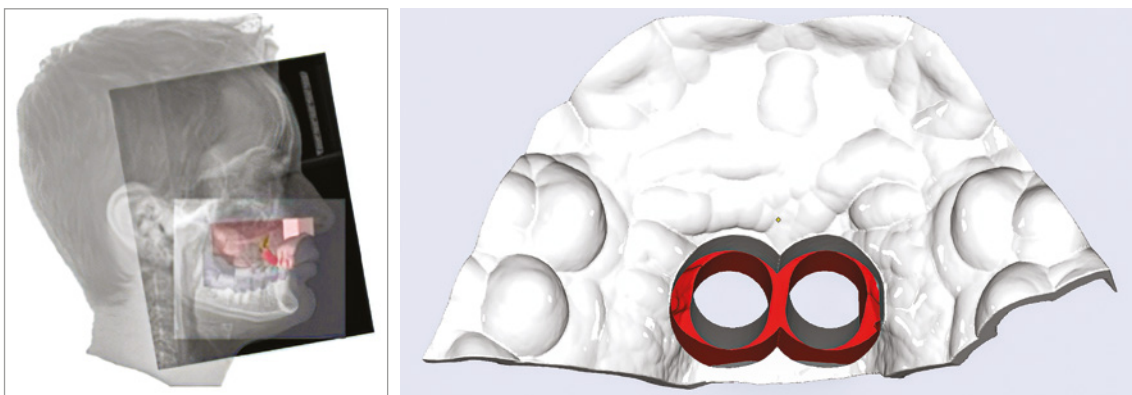


Figure 10: Digitally planed palatal mini-implant guide.

7) How do you feel about being a key opinion leader in orthodontics? (Jorge Faber)

First, I personally don't like the term key opinion leader (KOL). It's frequently used by the industry for their top paid speakers. It is not clear what kind of clinical, scientific or ethical achievements make one a KOL. Sometimes, orthodontic companies sponsor particular speakers as "good will", and not to promote a product. That has often been the situation when speakers are professors or teachers. It seems that speakers are unfairly "lumped into" the same KOL category. Rather, my intention is to share, investigate and support, not to lead, and not a typical KOL.

8) How did you balance private practice/research/family and friends throughout your career? (Didem Nalbantgil)

Finding a good life/work balance is most difficult for me. I am often too enthusiastic about my profession and I get close to becoming a fanatic, and that might occupy a lot of my private and family time. Some years ago, I started to do sports (fitness and cycling) with my office team and family. Since then I have always been leaving office on time. I am fortunate that my family enjoys sports as much as I do. In addition, most of my close friends are either orthodontists or cyclists.

9) If your orthodontist career were just starting, which topics would interest you most? (Didem Nalbantgil)

I know that our basic character doesn't change much during our life. So, most probably, I would be interested in the same things I still am. That would be: all the surgical orthodontic stuff

and 3D technologies. My experience and good sense tell me it would be advisable to spend way more time in diagnostics, professional reading, doing better research and performing, as often as possible, low-tech (frugal science) treatments.

10) What do you think is the biggest future challenge for the new graduating orthodontists, and what are your recommendations for a young specialist in our field? (Didem Nalbantgil and Oyku Dalci)

Social media and company-driven orthodontics are the greatest challenge to our profession. When I started my orthodontic training, the role models at that time were characterized by:

- » Being a very good clinician (demonstrated by fully documented case presentations)
- » Publishing good research (Journals with some impact, e.g. AJODO, etc...)
- » Giving well thought out, relevant and ethical lectures

To be very provocative, today's superstars in orthodontics seem to be determined by the number of their social media followers. Re-assessing cases that were treated 30 years ago, one sometimes wonders why they look better than cases using 'high-tech' orthodontics today.

My advice (and I include myself) is:

- » Respect basic orthodontic principles of treatment planning.
- » Do not exceed the biological limitations.
- » Be ethical, do not use high-tech to impress the patient or your balance sheet.
- » Provide evidence-based orthodontics by applying the knowledge from relevant literature.
- » It is all about the patient and the treatment outcome.

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E-mail: bludwig@kieferorthopaedie-mosel.de

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

REFERENCES

1. Israel M, Kusnoto B, Evans CA, Begole E. A comparison between traditional and computer-aided bracket placement methods. *Angle Orthod.* 2011 Sep; 81(5):828–35.
2. Koo BC, Chung CH, Vanarsdall RL. Comparison of the accuracy of bracket placement between direct and indirect bonding techniques. *Am J Orthod Dentofacial Orthop.* 1999 Sep; 116(3):346–51.
3. Zachrisson BU. Multistranded wire-bonded retainers: from start to success. *Am J Orthod Dentofacial Orthop.* 2015 Nov; 148(5): 724–7.
4. Krüsi M, Eliades T, Papageorgiou SN. Are there benefits from using bone-borne maxillary expansion instead of tooth-borne maxillary expansion? A systematic review with meta-analysis. *Prog Orthod.* 2019 Feb 25; 20(1):9.
5. Wilmes B, Ludwig B, Vasudavan S, Nienkemper M, Drescher D. The T-Zone: Median vs. paramedian insertion of palatal mini-implants. *J Clin Orthod.* 2016 Sep; 50(9):543–551.
6. Isfeld D, Lagravere M, Leon-Salazar V, Flores-Mir C. Novel methodologies and technologies to assess mid-palatal suture maturation: a systematic review. *Head Face Med.* 2017 Jun 14; 13(1):13.
7. Hourfar J, Bister D, Kanavakis G, Lisson JA, Ludwig B. Influence of inter-radicular and palatal placement of orthodontic mini implants on the success (survival) rate. *Head Face Med.* 2017 Jun 14; 13(1):14.