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HANDBOOK

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IDEA

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The Future of Orthodontics: Crisis or Transformation

Nonlinear systems characterize the world, humans and orthodontics in that order. One characteristic of nonlinear systems is that they tend to remain stable for a very long period of time but are prone to violent fluctuations which then take time to settle into a pattern. A new normal emerges but by then change is already evident. The pandemic redefined the world with a heightened uncertainty and instability. The pandemic was an existential moment for humanity claiming an excess of 15 million lives, lockdowns and economic catastrophe yet an unstable world saw a major invasion, conflict points and the ability to create vaccines and convert an existential threat to a preventable health hazard. In the words of Tim Palmer "long periods of boring and predictable behaviour, these nonlinear systems suddenly become wildly unpredictable, exhibiting extreme fluctuations."

Is Orthodontics heading for a period of instability? Looking at the future of Orthodontics, are we in a period of crisis or is it transformation to a new norm. The theme for the deliberations of the first IIOS Coorg hosted in association with the EAO and the IOS was based on premonition because it preceded the pandemic. The signs of a change were in place and the lockdowns perhaps became the inflection point for change. How often were patients seen in practices? New case starts? which treatment strategies fared the best for doctors and patients. Literature shows no real damage happened to patients in treatment. Yet remote monitoring worked best for the aligner patients where treatment progressed without a break. The presentations from around the globe brought an implicit message that aligners were fast looking at a mainstream position in clinical orthodontics. 25 to 30 % of case starts in varied places have transitioned to aligners. In house aligners are still a matter for consideration where the simple issues and retainers both active and passive are printed in house but complex cases still go to major players like Invisalign, Ormco, Dentsply and others for the requirement of time and tech in creating treatment plans. Detailed clinical presentations show an orthodontic vista which now relies on biology and technology rather than a tooth first paradigm.

Artificial Intelligence is the current flavour of the month and everyone seems to be on the bandwagon. A brilliant concept presentation from Jordan brought home the entire ecosystem of AI orthodontics and its future. Our own experience at CIDS in creating an extraction prediction algorithm was constrained by a paucity of data and recording outcomes. This is the new holy grail of orthodontics, an inherent need to close the loop in clinical practice, to record quantitatively both the hard tissue and aesthetic outcomes if we are to work AI into predictive pattern recognition and this would be a wide range over age, sex, ethnicity and geography.

The future in orthodontics now lies in a change, in teaching - learning the specialty. The concept of biomechanics and force systems outside the C_{rot}/C_{res}, moments generated in a limited bracket wire interface will need to contend with compressive forces that the aligners bring to bear on an entire tooth morphology. The understanding digital pathways and predictive treatment planning with an outcome defined even before the start of treatment is the new normal. A specialty obsessed with precise finish, in fractions where the humble twin bracket was repeatedly redesigned for precise fit, ligation, built-in mechanics had already moved to the self-ligation appliances which provided much more freedom in the system rather than the rigidity expressed in the earlier classic appliances. Where will go with aligners. The patients have had a strong role in this transition so has media and direct to consumer marketing. We await the future with bated breath and hope the instability will settle while the industry will struggle with the huge capacity build on bracket and wire technology and manufacture. Change is inevitable.

We are grateful to our eminent panel of speakers who brought in the harbingers of change in their shared experiences and presentations.

The social interactions reaffirmed the adage "Vasudhaiva Kutumbakam" in Sanskrit which means the 'world is one'. We are grateful for all those who came and shared these very exciting moments together. Our gratitude to the EAO and IOS who supported this first ever effort and all our friend around the globe who travelled to be with us.

Till We Meet Again

Anmol S Kalha

Professor Emeritus, Scientific Chair IIOS 2023.

The First India International Orthodontic Symposium guiding the Transformation of Orthodontics

Orthodontics and medicine are progressing through an interesting transitional phase driven by innovations, techniques and the necessity to adopt to a new normal after the Covid-19 pandemic.

Little did I imagine in 2019 when Prof. Kalha and I along with Prof. Ralf Radlanski, Prof. Aladin Sabbagh and Dr. Jan Raiman thought of holding this symposium on the future of Orthodontics that the world would be crippled by a pandemic of such proportion. Surprisingly many chosen topics for the oration had a direct bearing on the pandemic and post pandemic changes that have occurred in methods of teaching Clinical Dentistry.

One such topic was the use of Predictive Algorithms for patient follow up and care. The pandemic saw several such algorithms being used to provide long distance and remote patient care.

The lessons learnt during the pandemic also helped us and our invited speakers better understand how Orthodontics is transforming and adapting to the new challenges. Dr. Radlanski in his oration spoke of the learning curve with aligners and initiated the proceedings, Dr. Sabbagh followed with his oration on TADS and the proceedings went on for two enlightening days with speakers from around the globe speaking and interacting with budding Orthodontics from India, Europe and South Asia. Dr. Raiman delivered a captivating lecture on interdisciplinary orthodontics for optimum function at the symposium. His presentation provided valuable insights into the collaborative approach required for successful interdisciplinary cases.

It was a pleasure having Prof. Anil Kumar Chandana, Prof. Peter Borbely, Prof. Chung H Kau, Dr. Simona Dianiskova, Dr. Ivana Dubovska, Prof. Dhirawat Jotikasthira, Prof. Nezar Watted, Dr. Shadi S. Samawi, Prof. Sridevi Padmanabhan, Prof. O P Kharbanda and Dr. Rajat Mitra who took time from their commitments to be with us at Coorg. I also thank Dr. Balvinder Singh Thakkar and Dr. Silju Mathew for gracing the event with their presence.

I would like to recognize the efforts of the scientific committee under the leadership of Dr. Kalha which ensured the presence of a galaxy of International experts at CIDS. I also recognize the efforts of Dr. Shashidara R, Dr. Goutham Reddy, Dr. Sanju Somaiah, Dr. Sujith Mathew and Dr. Akshatha for the success of IIOS 2023.

The conference received support from the Rajiv Gandhi University of Health Sciences, Bengaluru, Dentsply Sirona, Garmy and Smile aligners along with many other well-wishers to whom we are grateful. I am delighted that the proceedings of this conference is being brought out in the form of a special Edition which will enable the thoughts of the experts to be preserved for posterity.

Dr. Sunil Muddaiah

Organizing Chairman

IIOS 2023

Sl. No	Speaker	Presentation Title
1	Dr. Aladin Sabbagh	Fascination and Limits of the Non-compliance Orthodontic TAD´s / SARA
2	Prof. Dr. Chung H. Kau	Orthodontics and Imaging Technologies - 20 Years of Evolution
3	Prof. Dr. Dhirawat Jotikasthira	TRPS1 (Trichorhinophalangeal Syndrome Type I): a Orthodontic Treatment Progress Report
4	Dr. Ivana Dubovska	Impacted Incisors
5	Dr. Jan V. Raiman	Interdisciplinary Orthodontic Treatment for Optimal Function in Every Age
6	Prof. Dr. Nezar Watted	Creating a Smile! - Integrated Management for Optimising Aesthetics & Function in Dentistry
7	Prof. Dr. O.P. Kharbanda	Automation in Cephalometric and Volumetric Craniofacial Imaging: Are We There?
8	Prof. Dr. Peter Borbely	What Happens After the Orthodontic Treatment has been Completed?
9	Col. Dr. Rajat Mitra	TMD - A Challenge for Orthodontics
10	Prof. Dr. Ralf Radlanski	Aligner Treatment - My Mistakes and My Learning Curve
11	Dr. Shadi S. Samawi	Orthodontic Diagnosis in the age of AI: A Revolutionary Evolution
12	Dr. Simona Dianiskova	Benefits of the Invisalign Treatment in Young Children and Teenagers
13	Prof. Dr. Sridevi Padmanabhan	Enamel Homeostasis in Orthodontic Treatment
14	Dr. Poomsthira Jotikasthira (Rising Stars)	Converting Digital Imaging and Communications in Medicine (DICOM) File from CBCT to Stereolithography (STL) File using Materialise Mimics Software for Estimating Alveolar Cleft Volume in Unilateral Complete Cleft Lip and Palate (UCCLP)
15	Dr. Eva Viesenbacher (Rising Stars)	Sagittal Mandibular Distraction Osteogenesis
16	Dr. Badarinath S (Rising Stars)	Efficacy of Clear Aligners - the Importance of Physical and Mechanical Properties of the Aligner Material

Fascination and Limits of the Non-compliance Orthodontic TAD´S / SARA

Dr. Aladin Sabbagh, Hisham Sabbagh

Apothekergasse 2, 91054 Erlangen, Germany

The treatment of patients with poor motivation and discipline is an everyday challenge in the orthodontic practices and clinics, a quick non-compliance technique is often the only promising therapy

The new SARA® appliance (Fig.1) is developed based on the concept of "progressive bite jumping" by A. Sabbagh 1995. This concept mainly differs from Prof. Herbst, one bite jumping concept from 1905 in following points:

- Significantly more effective step by step advancement instead of a single step advancement
- The SARA® Spring can be used in a time-saving and cost-saving manner directly on the existing multi-bracket apparatus without laboratory work (soldered or cast anchoring units).

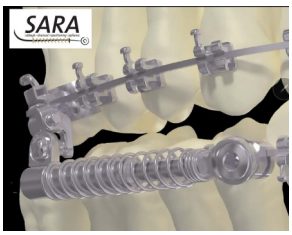


Fig 1. SARA

Indications

- Distal bite / class II unilateral/bilateral >> avoiding orthognathic surgery and Extractions
- Molars mesialization in the lower jaw / gap closure (with aplasia of the 5s)
- TMD decompression / sleep apnea therapy

The new histological and MRI findings, open up the possibility of treating borderline distal bite adult patients up to 5 mm over jet, without orthognathic surgical correction.

In particular, the use of the Aquasplint (Fig.2) in adult patients to treat TMD and eliminate a dorsal forced position of the mandible has proven to be an effective pre-orthodontic treatment, after a wearing time of 10 hours per day for about 4 weeks, the TMD symptoms have been significantly reduced and the mandible has evade its forced position and repositioned moderately in a ventral direction (Fig.3) reducing TMD symptoms as well as overjet which simplifies the orthodontic rehabilitation and improve the air ways.

Fig 2: Aqua

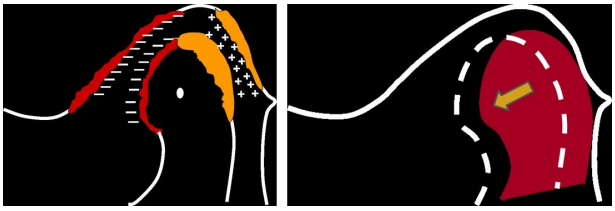


Fig 3: Decompressor

Hybrid Orthodontic

Despite all the advantages of aligner therapy, the treatment of non-compliance patients requires a short treatment period in order not to overstrain the available poor motivation and to avoid white spots and decays.

Aligner modifications such as Hemi-Splint© (Fig.4) , Torque Power Point / TPP© (Fig.5) , SARA-Splint® (Fig.6), as well as the combination of aligners and fixed appliances such as braces and Tad`s / Mini-Implants (Fig.7), RME-Distractors (Fig.4), can help overcome aligners limitations, expand the range of indications, and reduce treatment duration and relapses.

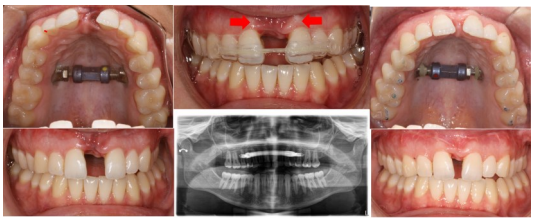


Fig 4: Hemi-Schiene

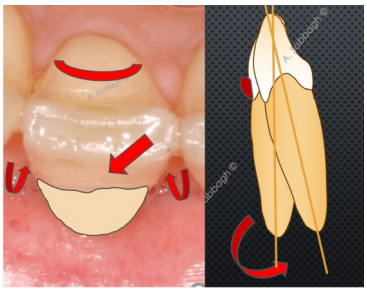


Fig 5: TPP

Fig 6: SARA Splint

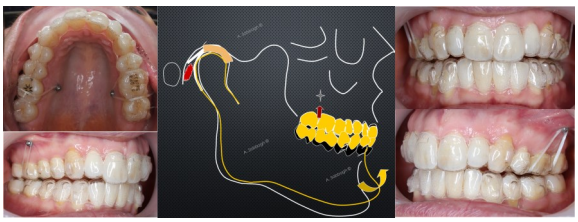


Fig 7: Tad's

Long term stability

To counteract relapse tendency, its recommended to over correct class II cases in super class I / edge to edge position, to use SARA®-Splint (Fig.6) retention as a night guard for at least one year, as well as to insert a fixed incisors retainer.

SARA® splint

The "Sabbagh Advanced Retention Appliance" ® first developed and published 2012 is used mainly for bimaxillary retention; but also for moderate relapse treatment and for sleep apnea, these are graceful 1 mm retention vacuumed splints. The wings (Fig.6) can be used to stabilize the sagittal treatment result (the other way round, also in class III cases). They offer advantages such as greater wearing comfort and thus greater patient acceptance, as well as longer wearing times and three-dimensional stabilization of the teeth position. There is no impairment of breathing and no unconscious loss of the retention appliance at night. In addition, the simple production in the own practice laboratory enables the maintenance of the economic efficiency.

Summary

The noncompliance appliances enable sufficient harmonization of the craniomandibular system mostly without extraction or orthognathic surgery, thanks to the effectiveness of the progressive bite jumping, The Aqua-Balance-Concept, and the improved retention technique, stable treatment result is achievable in shorter time with less efforts and relapse.

Orthodontics and Imaging Technologies - 20 Years of Evolution

Prof. Dr. Chung H Kau

Chairman, Department of Orthodontics, University of Alabama, Birmingham

Orthodontics has changed in many ways over the last decade.[1] The speed of knowledge transfer has changed our information gathering which has affected not only the consumer but also the professional. In the past, patients would carefully observe the treatment prescriptions of the physician or health care provider. However, advertising in medicine allowed drug companies to influence consumer behavior by broadcasting key clinical messages on billboards, radio, or television. The internet revolution meant that data was readily available with the touch of a button on a computer screen. The readily accessible data has empowered many consumers to make informed decisions. This was no different in medicine, dentistry, or orthodontics. Today, patients practice prosumerism, a term used to describe the active involvement of a patient in seeking the type of care they feel they need and to identify the right clinicians who will deliver these treatments.

Probably the best example of prosumerism in Orthodontics is the successful marketing campaign that Invisalign created to the Orthodontic industry. In the early years, many orthodontists were reluctant to embrace this new technology. However, the internet greatly enhanced the company strategy which allowed Invisalign to be marketed directly to an Orthodontic patient audience. This new marketing strategy not only created awareness about the Invisalign product, but it also filled a gap that patients wanted. For example, a clear, clean, and easy method to straighten teeth at the patient's convenience. Align technology, the makers of Invisalign, went one step further, and certified orthodontic providers and re-directed patients to the clinics of orthodontists or dentists who highly used their products. Today, the Invisalign product is the leading brand of clear aligners.

The rapid usage of 3-D technology has also changed Orthodontics. (Fig 1) Currently, a true virtual patient [2] can be obtained for diagnosis [3], treatment planning and customized orthodontic appliances. Many applications include understanding faces in populations, [4] surgery planning, [5] customized orthodontic appliances, and 3D jaw tracking. [6] These amazing advances mean that the Orthodontic profession must constantly educate themselves on the latest and most up-to-date technologies. While the delivery of orthodontic care does not change with traditional biomechanics, the methods of delivery are certainly changing. Clinicians must adapt to the new ways of treatment delivery. An example of research of such innovations lies in the accuracy of 3D planned results and the actual delivered clinical results. (Fig 1) Other examples include the use of other vast arrays of 3D aligners in the marketplace (Fig 2).

The future is both exciting and challenging for our profession. We must stay ahead of technological advances and continually improve our workflows to deliver the best care for our patients.

Fig 1: A modern depiction of patient records in a 3D manner

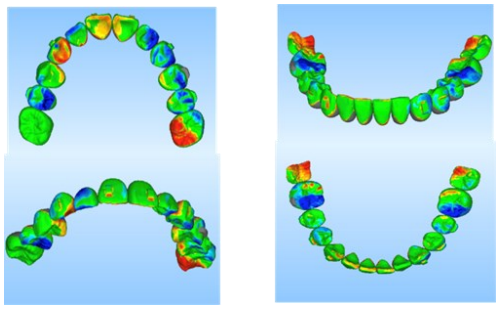
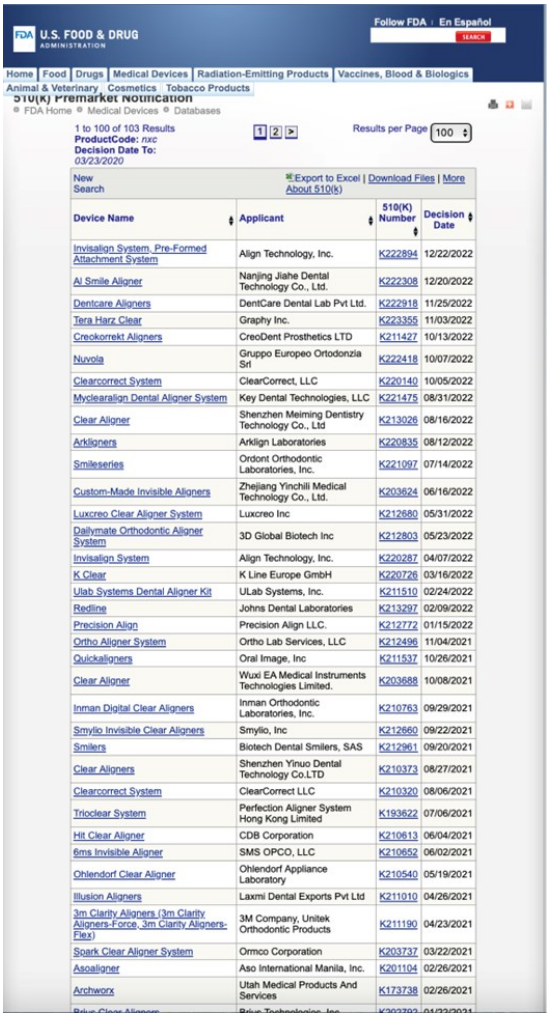


Figure 2: Superimpositions of intra-oral scans of a patient at T20 versus the planned computerized treatment changes. The average difference in clinical versus planned results were less than 0.2mm. (Pictures with thanks from Smartee Aligners, Shanghai China)



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510(K) Premarket Notification

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ProductCode: nxc
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Device Name	Applicant	510(K) Number	Decision Date
Invisalign System, Pre-Formed Attachment System	Align Technology, Inc.	K222894	12/22/2022
Ai Smile Aligner	Nanjing Jiahe Dental Technology Co., Ltd.	K222308	12/20/2022
Dentcare Aligners	DentCare Dental Lab Pvt Ltd.	K222918	11/25/2022
Tera Harz Clear	Graphy Inc.	K223355	11/03/2022
Creokorrekt Aligners	CreoDent Prosthetics LTD	K211427	10/13/2022
Nuvola	Gruppo Europeo Ortodonzia Srl	K222418	10/07/2022
Clearcorrect System	ClearCorrect, LLC	K220140	10/05/2022
Myclearalign Dental Aligner System	Key Dental Technologies, LLC	K221475	08/31/2022
Clear Aligner	Shenzhen Meiming Dentistry Technology Co., Ltd	K213026	08/16/2022
Arkligners	Arklign Laboratories	K220835	08/12/2022
Smileseries	Ordont Orthodontic Laboratories, Inc.	K221097	07/14/2022
Custom-Made Invisible Aligners	Zhejiang Yinchili Medical Technology Co., Ltd.	K203624	06/16/2022
Luxcreo Clear Aligner System	Luxcreo Inc	K212680	05/31/2022
Dailymate Orthodontic Aligner System	3D Global Biotech Inc	K212803	05/23/2022
Invisalign System	Align Technology, Inc.	K220287	04/07/2022
K Clear	K Line Europe GmbH	K220726	03/16/2022
Ulab Systems Dental Aligner Kit	ULab Systems, Inc.	K211510	02/24/2022
Redline	Johns Dental Laboratories	K213297	02/09/2022
Precision Align	Precision Align LLC.	K212772	01/15/2022
Ortho Aligner System	Ortho Lab Services, LLC	K212496	11/04/2021
Quickaligners	Oral Image, Inc	K211537	10/26/2021
Clear Aligner	Wuxi EA Medical Instruments Technologies Limited.	K203688	10/08/2021
Inman Digital Clear Aligners	Inman Orthodontic Laboratories, Inc.	K210763	09/29/2021
Smylio Invisible Clear Aligners	Smylio, Inc	K212660	09/22/2021
Smilers	Biotech Dental Smilers, SAS	K212961	09/20/2021
Clear Aligners	Shenzhen Yinuo Dental Technology Co.LTD	K210373	08/27/2021
Clearcorrect System	ClearCorrect LLC	K210320	08/06/2021
Trioclear System	Perfection Aligner System Hong Kong Limited	K193622	07/06/2021
Hit Clear Aligner	CDB Corporation	K210613	06/04/2021
6ms Invisible Aligner	SMS OPCO, LLC	K210652	06/02/2021
Ohlendorf Clear Aligner	Ohlendorf Appliance Laboratory	K210540	05/19/2021
Illusion Aligners	Laxmi Dental Exports Pvt Ltd	K211010	04/26/2021
3m Clarity Aligners (3m Clarity Aligners-Force, 3m Clarity Aligners-Flex)	3M Company, Unitek Orthodontic Products	K211190	04/23/2021
Spark Clear Aligner System	Ormco Corporation	K203737	03/22/2021
Asoaligner	Aso International Manila, Inc.	K201104	02/26/2021
Archworx	Utah Medical Products And Services	K173738	02/26/2021

Fig 3: 103 Aligner companies with 510K approval in the US Market

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TRPS1 (Trichorhinophalangeal Syndrome Type I): An Orthodontic Treatment Progress Report

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ABSTRACT

Trichorhinophalangeal syndrome, type I (TPRSI) is an autosomal dominant disorder that includes skeletal anomalies with cone-shaped phalangeal epiphyses, and a characteristic face with sparse scalp hair, bulbous tip of the nose, long flat philtrum, thin upper vermilion, and protruding ears [Maas et al., 2015]. It is caused by mutations in zinc finger transcription factor TRPS1 (OMIM 604386). A Thai male with TRPS1, who carried a c.1842C>T (p.Arg615Ter) mutation, had double mental foramina, hypoplastic mandibular condyles with slender condyle necks. Orthodontic treatment planning needed 23 extractions (15 supernumerary and 8 permanent teeth) as well as vertical and sagittal orthodontic control using TADs for entire arch distalization of both upper and lower dentitions in order to correct upper and lower crowding, upper dental midline deviation and anterior crossbite. The presentation includes the contribution of imaging science in dentistry and simulation software for orthodontic diagnosis and treatment planning.

Impacted Incisors

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Impacted incisor are among anomalies which bother patients and parents the most. The parents of a child with an unerupted central incisor are usually be motivated to seek treatment much earlier than parents of a child with almost any other orthodontic problem.

Prevalence of non-eruption or impaction of maxillary central incisors is 0,1–0,5% [1]. Early and accurate diagnosis of maxillary central incisor impaction is important in preventing and treating this condition. Disturbances in the development and eruption of central incisors may result in serious problems related to function and aesthetics of the dentition [1]. Early treatment is important for the following reasons: 1) unerupted maxillary central incisor can caused unesthetic appearance, oral function, and speech failure, 2) it can cause tipping of adjacent teeth, thus reducing the space for the unerupted incisor, 3) it is a significant environmental influence in delaying and altering the eruption path of permanent canine.

Central incisor impaction should be suspected in case the central incisor does not erupt within 3–6 months after eruption of the central incisor in the opposite antimere; in case of improper sequence of eruption (lateral incisors erupt before central incisors); if atypical shape of the alveolar ridge is present or conversely in case of an underdeveloped alveolar ridge at the site of an unerupted central incisor; and if the deciduous central incisor is still present during physiological replacement [1]. Central incisor impaction is mainly caused by an obstacle in the eruption path (supernumerary tooth or odontoma), injury, or by a deviated eruption path.

The diagnostic workup for impacted maxillary incisor involves history-taking (focused on injury, premature loss of deciduous teeth, or the presence of supernumerary tooth), clinical diagnosis, and definitive confirmation by radiologic examination. To confirm the diagnosis the periapical X-ray projection is the first option that often reveals the cause of impaction [1]. Panoramic radiograph used for overall diagnosis might be unsatisfactory for incisor impaction detection because projection of the collar bone in the area of central incisors, that exposes the risk of overlooking e.g. supernumerary tooth. Cephalometric x-ray can clarify vestibulo-oral position of impacted teeth. CBCT is used for diagnosis of dilacerated teeth or other complications (resorption, ankylosis) [1].

In addition to providing detailed information on the location of the impacted incisor tooth, CBCT´s advantages include the possibility to determine its precise relationship to adjacent teeth (especially supernumerary teeth) and other structures, morphology of the tooth (possibly dilaceration), as well as the possibility to identify the extent and location of resorption in adjacent teeth. A disadvantage of CBCT is a higher dose of radiation in combination with low age of the patients.

Newer type for visualizing impacted teeth is using technology of mixed reality with Microsoft Hololens 2 glasses. It allows to view 3D model of jaw from all different angles, and it is possible to estimate the direction of future traction.

Model of impacted teeth is made using CBCT data and transfer to mixed reality application 2, 3. It is a great tool for impacted teeth visualization, treatment planning and communicating with patients, parents and collaborating specialists. It’s allowing better communication with the surgeon by letting to exactly mark place where you want to have active traction on the impacted tooth or with the technician to let him know where to place the arm for traction.

It helps orthodontist not only visualize the impacted tooth itself, but also estimate a traction direction. For example in impacted canines it is possible to visualize the point when you need to change traction from uprighting and extrusion of the tooth toward the dental arch. Very helpful is setting tractions lines for dilacerated incisors, which is complicated with other tools. Another usage is remote visualization so there is no need to be present personally during surgery – if surgeon have Hololens glasses you can see the procedure from his perspective or if there are 2 Hololens devices you can walk around operating table and you can see area of interest from different angles and places. The only disadvantage is the necessity for technician to segment the virtual 3D model from CBCT and place it in special application.

Treatment of impacted incisor differ according to cause of impaction.

Cause of impaction we can divide in obstruction causes, deviated eruption path or trauma cause.

There are two types of obstruction causes: lack of space where normally erupted neighboring teeth cause eruption obstruction and "real" obstruction, where something gets in the eruption way - mostly supernumerary tooth.

In the case with lack of space orthodontist opens the space, mostly with fixed appliances. If the tooth did not spontaneously erupt 3months after space opening new x-ray is recommended. If there is sign of eruption of the impacted incisor we are waiting until 6 months, if there are no changes in the tooth position active traction is recommended after 6months. If the space loss is caused by overall orthodontic anomaly, we treat this anomaly (e.g. in lateral crossbite transversal expansion is indicated).

Fig 1: A) Patient with upper left central incisor impaction because lack of space B) Transversal expansion with acrylic hyrax to treat lateral crossbite and create space, spontaneous eruption of 21 stopped after 4months so active traction with partial fixed appliance were done C) After interceptive treatment, retention with fixed retainer

It is very important to know which type of supernumerary tooth is cause of impaction.

In permanent dentition most common type of supernumerary tooth is conical type (75%). Tubercular type occurs in 12% of cases and mostly cause impaction. Supplemental type is in 7% and odontoma in 6% of cases [4].

Treatment of impacted incisor caused by supernumerary tooth is extraction of the latter. The only exception is when we use supernumerary as donor tooth for auto-transplantation if it is appropriate. Spontaneous eruption of the impacted incisor after removal of supernumerary teeth occurs in 36%-75% [5-7] according to the literature. With simultaneous space opening the probability rises up to 90% [8].

Spontaneous eruption depends on vertical distance of the impacted incisor to the occlusal line, angle to vertical reference line, type of supernumerary, on the surgical procedure (if follicular sac is damaged during removal, incisor will not erupt), patient age and spatial ratios in dental arch.

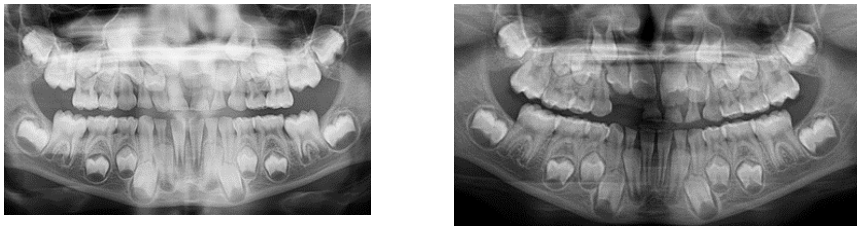

Fig 2: A) 7 years boy with supernumerary deciduous right distal lateral incisor and supernumerary right mesial permanent incisor without root development. B) 6 months after extraction of supernumerary teeth and deciduous right lateral incisor - incisors erupt spontaneously.

Deviated eruption path is another impaction cause.

If there is enough space for impacted incisor and we are sure that there is no reason for impaction as supernumerary tooth or injury, we can just wait. 6 and 9 months after we are checking eruption changes. If there is no change in 9 months control in the incisor position we need to add active traction [9]. Active traction is done after space opening with fixed appliances always with closed surgery technique. We try to avoid vertical cuts, because they can cause scars and pull of soft tissue subsequently causing bone loss. Eyelet with gold chain is placed on palatal side of incisor crown. Traction is directed palatally or on the top of alveolar ridge. We mostly use transpalatal bar with arm to lead active traction in desire direction.

In our study on CBCT we found that crown of an impacted incisor exhibits more significant protrusion than that of a fully physiologically erupted tooth. We can conclude that the direction of active traction should be palatally which will allow for an adjustment of the labial inclination. After adjusting the inclination, or in a group of impacted central incisors with very slight labial inclination, active traction is directed straight to the top of the alveolar ridge. It would be a critical failure to direct the traction vestibulary, particularly in incisors with greater labial inclination. The result of this vestibular traction (for example traction straight to the continuous arch) in an unaesthetic lengthening of the clinical crown, often also due eruption of the tracted incisor apically to the marginal gingiva. Very useful in this situation is placing the button on the pallatal side of impacted tooth.

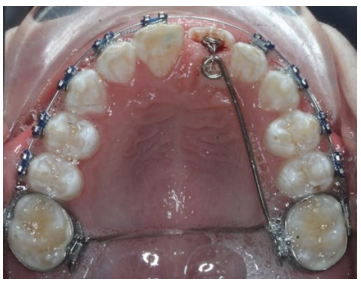

Fig 3: Direction of active traction toward palate and to extrusion

Fig 4: Closed surgery without vertical cuts recommended

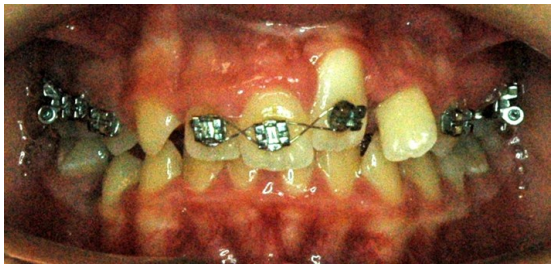

Fig 5: A) Closed surgery with vertical cuts which have caused loss of bone mesially of 21 and gingival recession . B-C) Extracted impacted imcisor was substitute by transposed pallataly impacted canine with build up. D) after treatment

Injury

Most common complications after injury of deciduous incisors or permanent incisors are ankylosis, dilaceration or loss of teeth. Dilaceration and ankylosis of incisor are cause of incisor impaction. It is better to prevent the complications than to treat them later. Fixation with fixed appliances make physiological movement possible, so it's better for ankylose prevention than traditional rigid fixation. We are always using a passive wire. Fixation should be 2-4 weeks for periodontal healing (subluxation, luxation, avulsion), or 4-8 weeks for bone healing after fracture. (4 weeks until 8 years, 6 weeks for adolescents, 8week for adults) [10]. Treatment possibilities with best aesthetic outcome of ankylosed or loss incisor are space closure (with build-ups) or auto-transplantation [10-14].

Fig 5: A) Lower right second premolar auto-transplantation in the place of extracted ankylosed upper central incisor. B) After 5 years, 2 years after auto-transplantation starts orthodontic treatment and provisional build-up was done. C) X-ray after auto-transplantation. D) 5 years follow up x-ray after auto-transplantation.

Conclusions

- In obstruction cases after space opening and removal of supernumerary possibility of spontaneous eruption depends on vertical distance of the impacted incisor to occlusal plane, inclination to vertical reference line and type of supernumerary tooth.
- Treatment plan of impacted incisors depends on overall anomaly and its treatment plan. If there are more treatment possibilities in cases with anomaly incisor morphology is better to choose those with space closure or auto-transplantation.
- Surgical procedure for impacted incisors should avoid vertical cuts.
- The crown of impacted incisor shows more vestibular inclination; therefore we can conclude that the direction of active traction should be palatally or to the top of the alveolar ridge, which will allow proper adjustment of the labial inclination.
- Patients with history of injury or auto-transplantation need to be checked radiographically, 1,3,6,12,18, 24 months and then every year 15.
- Is better to prevent complications in trauma cases that to treat them. Orthodontist should be the first aid doctor.

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Interdisciplinary Orthodontic Treatment for Optimal Function in Every Age

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We live in times, where teaching and research is constantly evolving. New methods and devices are constantly being constructed to make our medical work easier in the movement of teeth. Behind every modern technique, however, there are also efforts to make them applicable as universally as possible with every patient, at every age and as far as possible worldwide. Old well established and tested treatment methods are being replaced by new ones and their introduction in the day-to-day practice costs a lot of time and energy. Doing so, we may as well slowly lose track of what the patient actually needs at his or her age. We try to adapt the type of treatment with the technical specifications in the foreground, and in that process we may lose the medical competence to bring about the right and successful therapy for the patient at the right time with minimally invasive treatment.

After almost 40 years of working as an orthodontist, I have had enough time to see how children and adolescent patients become adult patients, and to observe how successful and effective you can be as a doctor if you can prevent many things at the right time with minimal impulses and good motivation that later can only be mastered with higher technical effort.

Every orthodontist should keep this in mind throughout his or her life.

1. Springtime – Orthodontic treatment for children, age 4-10

Function-Driven Orthodontics (Form Follows Function)

- **Extraoral findings/ orofacial bad habits**

The first season in orthodontics is springtime. We start with extroral findings: We have to recognize any malfunction, and when necessary, we have to intervene with respect to the mental state of development. This comprises space management, control of habits, we have to strengthen muscle function, consider special needs of our cleft patients in general, all these measures have to be seen holistically and in connection with the total body posture.

Recognition and initiation of treatment of developmental deviations and malfunctions preservation and creation of space for permanent dentition the child's state of mental development

- genetically determined birth defects
- mouth breathing
- visceral swallowing
- frontal or lateral sigmatism, snoring
- thumb sucking, sucking - biting the upper and lower lip
- hypotonic orbicularis oris muscle, incompetent lip closure,
- cleft effects on soft tissues
- facial scoliosis, asymmetry
- accompanying phenomena - squinting / poor concentration at school / headaches

- **Functional analysis**

As you know, our functional analysis comprises function of the joint, control of posture, anomalies of the spine, leg length deviation, muscle function.

- jaw joint and anatomical or growth deviations
- posture imbalance, irregular asynchronous growth,
- scoliotic development of the spine,
- kyphosis - round back, lordosis - bulging belly,
- difference in leg length / pelvic posture

- vertical imbalance of the hip joints after swallowing or biting
- unusual muscle and fascia tone, flexibility of the body

- **Intraoral findings**

Now we come to our intraoral diagnostics: Oral hygiene first, soft tissues, language, bruxism, any kind of malocclusion, transversal deviations, effects of possible cleft pathologies, any previous loss of teeth, state of occlusion.

- state of oral hygiene
- vestibule, quality of attached gingiva
- frenulum, height/depth of gingival recessions, sublingual frenulum
- language function, impression, size, parafunction
- bruxism
- Angle's classification, class I, II, III malocclusion
  deviations in the sagittal, vertical and transverse planes,
  mandibular deviation
- cleft effects
- dentoalveolar or mandibular center deviation
- condition of the dentition and problems with the place for the permanent dentition
- premature extractions and tooth loss
- state of occlusion and control of congruence of dental arches

- **Therapy options**

We have a bundle of treatment options: Some intimidated patients must be slowly acquainted with our practice environment. Myofunctional treatment is essential in my eyes, as well an overall body health, particularly in young children! And intraorally, we have to manage any occlusion problems, including space management.

- the gradual habituation of the patient to the office environment, if necessary.
- myofunctional therapy including speech therapy and parent's role
- physiotherapist, osteopathic treatment
- neuromuscular training with imaginary activator, straight upright posture
- space maintaining devices
- treatment with a limited goal
- rapid expansion of the palatine suture (SARPE, MARPE)
- space management appliances
- recall

2. Summer - Orthodontic treatment for adolescents, age 10-20
Face-Driven Orthodontics (craniofacial orthopedics – orthodontics "alignment of teeth")

We do not at all only align teeth, but we perform craniofacial orthodontic treatment, correction of malocclusions included. And that is what we need to do in the Summer Season, monitor growth, or even intervene.

Adolescents are very sensitive in their self-perception and effect on their peer. Their self -confidence also depends very much on their faces. Here we as orthodontists are in demand and make a significant contribution to their psychosocial development. We can either apply functional orthodontics or in severe cases, surgical intervention, even during puberty. However, a high level of experience is required here.

Objectives

- tooth alignment and optimization of aesthetic and functional requirements
- influencing growth of the lower and upper jaw
- surgery first preparation, also consider the psychological development of the patient
- preparation for subsequent treatment of gaps by a dentist or implantologist in case of aplasia
- or prematurely extracted teeth, where the gaps were planned and prepared for the following treatment

- **Methods**

  - Pre-treatment - removable appliances, activators, myofunctional therapy (MFT)),
  - Angle-Class III (8-12 years)
  - Bollard implants (Prof Clerck) into the zygomaticomaxillary crest and canine region
  - Adhesively attached anchorage on teeth and Delaire mask
  - Treatment with fixed appliances, treatment with aligners, micro-implants, positioners

- **Retention**

  - fixed retainer lifelong
  - removable retainers for approx. 1 year
  - or even lifelong for self-control

3. Autumn - Orthodontic treatment for adults, age 20-50

Aesthetic-Driven Orthodontics (Removal of abrasions and other damages, relapse problems)

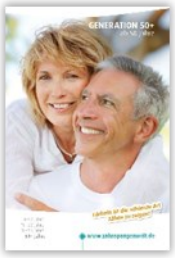
Not only young people, but also we adults communicate with our faces it always sticks out of the top of our clothes. And it is clear that we also have a lot to do here in orthodontics. Also plastic surgery is somehow a standard in terms of requirements then the teeth are also part of it, and only we can do that for our patients.

- aesthetic remodeling - elimination of recurrences
- malfunctioning damages
- preparation for surgical corrections after the end of growth

Treatment, invisible appliances preferred
- aligners
- lingual brackets
- vestibular brackets (ceramic!)
- adhesive, long-term retention

4. Autumn - Orthodontic treatment for seniors, age 50+

Prosthetic Driven Orthodontics (Complete restoration of worn teeth and Occlusion to save vertical Lowering and TMJ Disorders)



In the fourth season, in winter, or with the elderly, as I am already one, in this period the orthodontist is the decisive treatment coordinator. We orthodontists know how unstable the orofacial system actually is and we therefore have to coordinate the treatment with the other professionals. Because the teeth may have worn down and migrated away, the mandible is often in the wrong place. We have to recognize this and correct it before prosthetic measures possibly lock the mandible in a wrong bite position. Sometimes we have to fight for this position as a treatment coordinator, maybe the dentist was too fast and did not even think of referring the patient to us before start of any treatment by him.

- Requirements for securing and improving the chewing process and setting up a new centric relation
- Elimination of the consequences of continuous dental care - loss of teeth and excessive wear of the teeth
- Radical raising of the bite
- Pre-prosthetic and pre-implantological adjustments to the position of teeth and abutments so that a new reconstruction of occlusal surfaces is made possible
- Interdisciplinary cooperation is absolutely mandatory:
- orthodontist, family dentist, periodontist, surgeon, implantologist, dentist for prosthodontics

P.S. I am very grateful for many personal stimuli and insights from Professor Proffit and Professor Kokich on this topic.

Creating a smile! - Integrated Management for Optimising Aesthetics & Function in Dentistry

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ABSTRACT

The continuously growing esthetic awareness for the facial appearance and the spreading of information about the possibilities of adult treatment by public media result in an increase of adult patients seek orthodontic treatment to improve their facial esthetics. In general, these patients show such a severe skeletal deformity that it is detectable even by non-experts because of its extraoral manifestation, which is the main motivation for treatment. Because of the nature of these deformities and because of the lacking growth usable for therapy the only promising treatment for these patients is the combined orthodontic-surgical approach. Besides a stable and functional occlusion with physiologic position of the condyle, the goals of treatment are the improvement of the dental and, above all, facial esthetics since the patient judges the success of treatment mostly by the extraoral appearance. The dentofacial appearance must be defined prior to treatment to plan the individual right approach in knowledge of the different treatment possibilities for Angle Class II deformities and thus be able to reach both sides patient and orthodontist- satisfying result. The aim of this paper to review the therapy concept to treat patients with Class II deformities and skeletal open bite with a long lower face (long face syndrome).

Keywords: *Cephalometrics, Orthognathic Surgery, Impaction of the Maxilla, Autorotation of the Mandible, Positioning of the Condyles, Facial Esthetics*

1. Introduction

Anterior open bite is the lack of overlap of the incisor teeth in centric occlusion. [1] Open bite malocclusion is found in 0.6% of the adult population in the USA. At a younger age, it is more frequent and accounts for 17% of all patients who undergo orthodontic treatment. [2]

Pre-surgical orthodontic preparation was uncommon for patients requiring orthognathic surgery until the 1960's. However, as surgical techniques advanced and the number of patients choosing an orthognathic approach increased, the patients' and clinicians' desire for optimal esthetic and occlusal results led to the most common current treatment approach. This approach involves pre-surgical orthodontic decompensation of the occlusal relationships and attainment of normal dental alignment. As most orthognathic treatment is planned now, there are two phases of orthodontic tooth movement, namely before and after orthognathic surgery. The disadvantages of having orthodontic interventions both before and after orthognathic surgery include a long treatment time and temporary worsening of facial appearance. Many patients become discouraged. [1-3]

Ever since the first orthognathic surgery procedure was performed by Hullihen in 1848, many new techniques and methods have been introduced. The introduction of orthognathic surgery widened the possibilities for treatment of severe malocclusions which could not be treated by orthodontics alone. As shown by Kondo and her colleagues, the limits of orthodontic treatment alone for severe malocclusions are broadening, but the underlying skeletal imbalances remain. Until the 1960's, orthognathic surgeries were usually performed without any pre-surgical orthodontic treatment. In fact, when Hullihen performed the first mandibular sub-apical osteotomy on a burn victim, he was able to correct the prognathism but created an edge-to-edge occlusion anteriorly. [29]

The three stage philosophy of orthognathic surgery was later adapted and is still valid today in the majority of cases. These stages involve pre-orthognathic orthodontic treatment to relieve the dental compensations followed by the orthognathic surgical procedure and finally post-surgical orthodontics to finish the case and settle the occlusion.

The aim of this paper to review the therapy concept to treat patients with Class II deformities and skeletal open bite with a long lower face (long face syndrome).

2. History and Initial Examination

The female patient presented at age 26-year-old. She complained about function, aesthetic disorders - difficult chewing function and the aesthetic impairment caused by the misaligned teeth and the incompetent lip closure.

The functional analysis showed that because of the impeded lip closure the mandible is habitually protruded to make mouth closure possible. Thus the condyles were displaced out of their physiologic position ventral and caudal towards the articular eminence. [31]

There was a corresponding functional anterior shift of the mandible from centric relation to maximum intercuspidation (habitual occlusion).

3. Diagnosis

The diagnostic records were taken in centric relation. For diagnosis and treatment planning the records with centric relation were taken.

Not only for diagnostic (centric relation) but also for therapeutic (TMD-symptoms) reasons a flat plane splint was inserted for 4 weeks which led to an improvement of the symptoms. In addition, the whole extent of forced bite was evident, the mandible was much more dorsal.

The facial photographs show insufficient mouth and lip closure in the centric relation. The lateral facial picture shows a posterior divergent face with protruded lip prominence and compared to the mid -face a long lower face (Fig. 1a, b). [33, 34] The patient had Class II dysgnathy, a skeletal and dentoaveolar open bite, narrow maxillary dental arch, tooth misalignment, and slight crowding in both dental arches (Fig. 2a-e).

Fig 1. a: Facial and lateral views in centric relation after insertion of the flat plane splint and prior to orthodontic treatment, an aggravated lip closure can be seen. b. The aesthetic axis is defined by the nose, jaw and chin. there is a deshormonia in the aesthetic axis

Fig 2. Intraoral Fotos before the beginning of treatment, distal occlusal on the right and left, increased overjet, crowding in both dental arches

Cephalometric analysis in centric relation elucidates a vertical and sagittal skeletal deformity and the dental analysis. The values indicated a skeletal open bite with extraoral manifestations of a long face syndrome: increased interbase angle (ML-NL= 37°) because of the posterior rotation of the mandible (ML-NSL= 45°), slightly reduced ratio of upper to lower facial height (PFH/PFH = 58%) while growth had been balanced.. The vertical distribution of the soft tissue profile showed a disharmony of upper to lower face (G´-SN : Sn-Me´ = 47%:53%). This could also be seen in the bony structures (N-Sna : Sna-Me = 41%:59%). There was also a disharmony in the lower face (Sn-Stms-Me´ = 30%:70%). [8, 9, 34, 48-50]

These changes in the ratio were not because of an alteration of the upper lip but more because of a lengthened lower face (Fig. 3, Table 1).

The Panorama Ex-ray shows no abnormalities (Fig. 4)

Table 1. Cephalometric analysis

Proportions of the soft tissue before and after treatment

Variable	Mean	Pre treatment (Centric relation)	Post treatment
G`-Sn / G`-Me`	50%	47%	49%
Sn-Me` / G`-Me`	50%	53%	51%
Sn-Stms	33%	27%	32%
Stms-Me	67%	73%	68%

Skeletal analysis: Average values or proportions of skeletal structures before and after Treatment

Variable	Mean	Pre treatment (Centric relation	Post treatment
SNA (°)	82°	82°	84°
SNB (°)	80°	77°	80°
ANB (°)	2°	5° (ind. 6,5)	4
WITS-Wert (mm)	± 1 mm	6 mm	4,5 mm
Facial-K.	2 mm	3 mm	1,5 mm
ML-SNL (°)	32°	45°	40°
NL-SNL (°)	9°	8°	11°
ML-NL (°)	23°	37°	29°
Gonion-< (°)	130°	137°	136°
SN-Pg (°)	81°	79°	82°
PFH / AFH (%)	63%	58%	61%
N-Sna / N-Me (%)	45%	41%	44%
Sna-Me / N-Me (%)	55%	59%	56%

Dental Analysis

Variable	Mean	Pre treatment (Centric relation	Post treatment
Interinc.-W. (°)	135	134	135
1-NL (°)	70	68	67
1-NS (°)	77	74	78
1-NA mm	4	5,5	4
1-NA (°)	22	25°	24°
1-NB mm	4	7	7,5
1-NB (°)	25	30	28
1-ML (°)	90	92	91

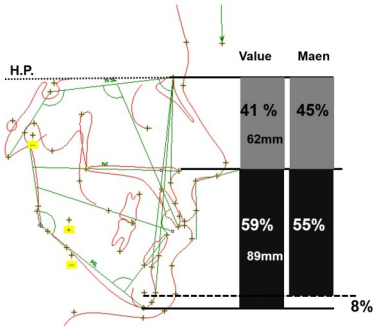

Fig 3. Cephalograms in centric relation after insertion of a splint. Tracings of the cephalogram prior to treatment; there is a soft tissue and skeletal disharmony in the vertical dimension.

Fig 4. Orthopantomogram (OPG) at the beginning of treatment

4. Treatment Plan and Goals

- Stable and functional Class I occlusion with physiologic position of the condyles
- Optimization of facial esthetics
- Physiologic mouth- and lipclosure
- Optimization of dental esthetics with consideration of periodontal health
- Fulfill the expectation and gain satisfaction of the patient
- Stabilize the result

Besides the stated treatment goals it was the special aim to improve facial esthetics not only in the sagittal but also in the vertical dimension. This was to be obtained by relatively shortening the lower face. Shortening of the lower face as causal therapy with corresponding effects on facial esthetics and lip function could be established only with a combined orthodontic-surgical approach [37, 48]. By solely orthodontic measures the pursued aims concerning esthetics and function could not have been reached. The deformity was too severe for a dentoalveolar compensation. Thus a maxilla osteotomy was planned for surgery. To improve the vertical dimension an impaction of the maxilla was necessary which should be greater dorsal than ventral. As consequence of the impaction the mandible with the condyles as “centers of rotation” . [43]

was supposed to autorotate sagittal and vertical; thus a displacement ventral and at the same time cranial of the pogonion was to be expected (Fig. 5). [21-23, 26, 45, 51]

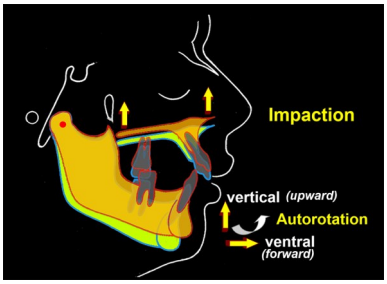

Fig 5. Simulation of the surgical impaction of the maxilla and the reaction of the mandible as described with cranial and simultaneous ventral autorotation.

5. Treatment

The case was treated according to the Watted-Würzburg treatment concept for orthognathic correction of a skeletal deformity and consisted of 4 phases. [48-50]

I) Presurgery Measures and Orthodontic Setup

1) "Splint therapy": A flat plane splint was inserted for 4 weeks to establish a physiologic centric relation of the condyles for final treatment planning and to reduce the temporomandibular joint pain. Thus the forced bite could be diagnosed to its whole extent. [10, 11] Diagnostic records with the wrong position of the condyles (because of the forced bite) would have led to a wrong diagnosis, treatment planning and not at last to a treatment with corresponding consequences for the result. [52, 53]

2) Orthodontic Preparation: The aim of orthodontic preparation was to develop the dental arches, to harmonize them in the three dimensions of space and to eliminate the dental compensation of the skeletal deformity. A conventional palatal expansion was performed for the expansion of the upper jaw Decisive for the preparation was the protrusion and torquing of the upper anterioirs not only to eliminate crowding but also with regard to the following surgery whereby the maxilla is impacted and rotated posteriorly. This procedure results in a more retruded position of the anteriors which must be taken into account in the preparation. Thus the presurgical labial inclination could be tolerated. For orthodontic preparation a multibracket appliance (0.022 bracket slot) was used. In the upper arch the first arch wire was a 0.014 NiTi.. Further arch wires were a 0.018 inch NiTi in the upper arch and 0.018x0.025in NiTi followed by a 0.019x0.025in steel in both jaws. The presurgery orthodontic phase lasted 9 months (Fig. 6a-d).

Fig 6. Clinical situation by the orthodontic preparation

3) "Splint therapy" to establish the centric relation 3-4 weeks prior to surgery. Aim of this procedure is to register a physiologic position of the condyle (centric relation) [52, 53]. An inaccurate position of the mandible results in an incorrect planning of the amount of advancement and with that in an inevitable relapse.

II) Surgery to Correct the Skeletal Deformity

After surgery on the casts, determining the amount of advancement and fabrication of the splints according to the system used in Würzburg (Four-splint-system: beginning splint or registering splint, maxilla impaction splint, mandible autorotation splint, finishing splint) [37, 38, 47]. A LeFort-1 osteotomy of the maxilla was performed where the maxilla was impacted cranial: 4,5 mm dorsal and 2mm ventral so that a posterior rotation of the whole maxilla resulted. With the autorotation of the mandible the sagittal deformity could be corrected. [15, 16, 35, 36, 39-41, 47] (Fig 7a, b)

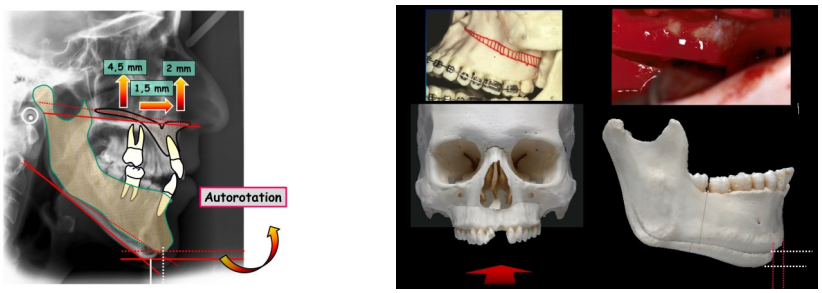

Fig 7. a, b: Planing of the surgical impaction of the maxilla and the reaction of the mandible as described with cranial and simultaneous ventral autorotation.

III) Postsurgery Orthodontics for Finishing

The earliest possible application of orthodontic forces after surgery is crucial to their impact. muscular forces are eliminated which otherwise would counteract tooth movements.
Thus on the 4th day after surgery postsurgery orthodontics were initiated [48, 49] with insertion of up and down elastics and for orientation of the muscles to the new position of the mandible light elastics. This phase lastet 3 months.

IV) Retention

Unwanted side effect from a mandibular advancement is the readjustment and reorientation of the affected soft-tissue and muscles and with that their force against the new position of the mandible. An advancement with transitional movement of the mandible results in stretching and strain of soft tissue and the suprahyoid complex. This tension must be regarded as relapse promoting [12, 19, 20, 24, 48, 49]. The MB appliance was removed 6 months after the operation. Removable retention devices have been incorporated in addition to the 3-3 retainer

6. Result and Discussion

The introral pictures show the final situation after the Treatment (Fig. 8a-e). Class-I occlusion on both sides and harmonising arches could be achieved. The extraoral pictures show a harmonic division of the face in the vertical dimension which was accomplished by shortening the lower face with surgery and a harmonic profile in the sagittal dimension. Profile of the mouth and lipclosure is physiologic (Fig. 9a, b).

A physiologic distance between maximum intercuspidation and centric relation could be recorded with manual functional analysis. There was no more pain of the temporomandibular joint.

Fig 8. a - e: Intraoral view after surgical correction of the deformity.

Fig 9. a, b: Extraoral views after treatment; natural mouth closure and attractive facial appearance

The cephalograms show the change of the variables (Fig. 10, table 1). Because of the surgical impaction and the posterior rotation of the maxilla the inclination of the maxilla was increased by 3°. With that and the following autorotation of the mandible the interplane angle was reduced by 8°. Impaction and autorotation resulted in a decreased anterior face height, which increased the posterior to anterior face height (PFH:AFH=61%) and thus harmonised this ratio.

The vertical division of the skeletal and soft tissue profile shows a harmonisation. The ratio of skeletal upper to lower face is 44%:56%. The disharmony of the lower third of the face was corrected so that the ratio Sn-Stm : Stm-Me´ equals 1:2 (32%:68%).

The autorotation of the mandible after impaction of the maxilla which is partially responsible for the correction of the distal occlusion [21-23, 26, 32]. The changes in the posterior teeth in the vertical and partially in the in the sagittal dimension are also effects of the impaction of the maxilla and autorotation of the mandible. The panoramic radiograph (Fig 11) show the material of the osteogenesis.

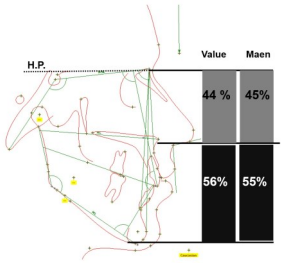

Fig 10. Cephalogram after treatment; there is a harmonisation of the skeletal (a) and soft tissue (b) structures in the vertical dimension.

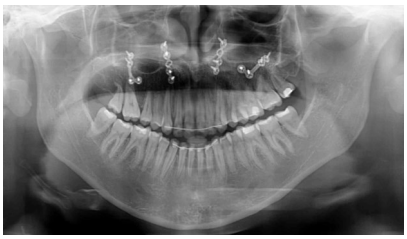

Fig 11. Orthopantomogramm after treatment

In accordance with the results of Radney & Jacobs [42] concerning cranial displacement of the pronasal point, follow up studies of Collins and Epker 14 and Rosen 43 concerning raising of the tip of the nose with impaction of the maxilla these effects could also be seen in the presented case. These results were also confirmed independently by several authors [4-7, 13, 17, 25, 27, 28, 30, 33-42], and especially by De Assis et al. [18] and Lee et al. [33].

The patient is clinically symptomless, joint- and chewing function as well as mobility of the mandible are unlimited.

The Patient was satisfied with the accomplished functional and esthetic situation after treatment.

7. Conclusions

According to the findings described in this paper, segmental orthodontic preparation combined with segmental upper jaw surgery produces satisfactory anteroposterior, vertical, and transverse (arch form and width) long-term corrections.

The results found in this study demonstrate that orthodontic surgical correction of dental skeletal open bite is clinically safe and stable in the long term. Further, the procedures as outlined within the paper are stable treatments of overjet, overbite, arch form, arch width, and maxillary accentuated curve of Spee deformities. Additionally, the correction was achieved without compromising facial esthetics and the airway. Likewise, it is important to establish the health of TMJ accurately, considering the influence that any anatomic condylar degenerative process may have on the long-term result.

By means of the systematic treatment approach presented, class II deformities with a skeletal open bite and long lower face can be treated with predictable success and without esthetic compromises. The treatment result shows that it is necessary to adapt the dentoalveolar Sitation to the skeletal dysgnathia to end with a satisfactory result with respect to function, esthetics and stability. It can be concluded that it is only possible to reach the preset treatment goals with an exact diagnosis and knowledge of the necessary orthodontic preparation in combination with the surgical procedure.

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Automation in Cephalometric & Volumetric Craniofacial Imaging: Are We There?

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ABSTRACT

The science and technology of 3D imaging at relatively low radiation and advanced software capabilities have enabled clinicians and researchers to perform three-dimensional visualisation, measurements and volumetric analysis of the craniofacial region.

The complexity of "on-screen" three-dimensional landmark plotting requires considerable effort and time, notwithstanding the operator's experience compared to landmark plotting on a 2D conventional cephalogram. Such issues necessitated the urge to automate the 3D landmark plotting and measurements. We have developed an innovative knowledge-based technique and tested its reliability to automate useful 3D cephalometric landmarks. We propose new on-screen 3D landmarks and 3-D cephalometric analysis. Another area of our research group's expertise is an automated volumetric analysis of paranasal sinus and nasal-respiratory passages using Artificial Intelligence (AI).

The presentation dealt with the possibilities of AI-enabled 2D ceph, automation of 3D cephalometry and volumetric imaging of functional spaces of the craniofacial region, which enhanced and added new dimensions to the understanding of malocclusion assessment and craniofacial anomalies.

What Happens After the Orthodontic Treatment has Been Completed?

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After the retention phase, which is the final stage of the orthodontic treatment, the teeth have a tendency to return towards their initial positions. The quality of the final occlusion will also affect the stability of the orthodontic outcome. The authors describe the factors that influence stability following orthodontic treatment.

About the risk and limitations of orthodontic treatment is necessary to inform the patient before starting the treatment. Among these are relapse, teeth extractions, problem of the third molars, etc.

Reduction of crowding by means of labial tipping of the anterior teeth is at high risk of relapse due to disruption of the functional balance.

Fig 1. At the beginning of the treatment and after 12 years the treatment ends the result is stable

It cannot be clearly stated whether extraction or non-extraction therapy leads to more stable results in the long term. To solve the frontal crowding by premolar extractions also does not seem to lead to a more stable result, equal the extraction of first or second bicuspids.

Fig 2. Photos of lower dentition with four premolar extraction treatment. a) before treatment b) immediately after treatment c) 5 years after treatment d) 13 years after treatment.

But why can it happen? Why is it difficult the keep the treatment result, especially for young adults? The answer is not an incorrect orthodontic treatment, but a new malocclusion, which the literature calls tertiary crowding. This occurs primarily in the mandibular incisors, after growth has finished.

Causes of tertiary crowding are:

1. differential growth (mandible grows stronger and longer (= cephalocaudal gradient))
2. forward growth and rotation of the mandible is stronger than maxillary growth
3. with the growth of the mandible the lower incisors tip lingually
4. intercanine width decreases with time
5. because of the canine guidance the lower front teeth tip lingually
6. according to the Begg theory with contemporary diet, there is no sufficient abrasion
7. the function changes with age
8. muscle tone becomes stronger
9. the teeth tip more and more mesially with age (angulation increases)
10. during the generations the teeth become relatively larger (the ratio between the teeth and the bone) due to the soft food, the jaws will be less burdened and consequent the jaws don't grow sufficiently

In short: the sources of post treatment changes are:

1 further growth
2 occlusal adaptations
3 facial and soft tissue changes.

All these also occur without orthodontic treatment too. The prevalence of mandibular incisor irregularity among untreated adults increases with age, with the greatest increases occurring during early adulthood.
Many authors mention the pressure of the wisdom tooth produces frontal crowding in the lower arch. Therefore, they advise preventive wisdom tooth extraction. But there is no statistically significant difference in the relapse of mandibular anterior crowding among the groups with and without mandibular third molars at the post-retention stage.
As Albin Oppenheim wrote in 1934: Retention is the most difficult problem in orthodontia: in fact, it is the problem.
In 2004 Little concluded: To obtain the best orthodontic treatment result, treat as well as you can, and then freeze it in place with fixed retention.

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TMD - A Challenge for Orthodontics

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1. Introduction

TMDs comprise a group of neuromusculoskeletal conditions that involve the TMJs, the masticatory muscles, and all associated tissues, and most common nonodontogenic cause of pain in the orofacial region. The condition varies from a single asymptomatic click to a chronic painful state with certain disability and has been shown to considerably influence a patient's daily life style [1].

2. The Background

Historically, the focus of dental professionals approaching patients with TMDs has been solely based on the assessment and correction of purported abnormalities of the occlusion since Otolaryngologist Dr James Costen way back in 1934 found unexplainable symptoms around the preauricular area of some individuals without molar support [2]. The absence of a full dentition was assumed to cause posterior condylar displacement in the TMJ, with subsequent symptoms due to compression on retrodiscal tissue and ear structures. Even though Costen's original etiologic proposals later were largely refuted, they created an initial platform for the dental science to enter in the field with number of occlusal based propositions for initiation and amplification of TMDs with dentists as the primary caregiver for such patients [3]. In this regard role of Orthodontist used to be considered paramount in prevention and curing of TMDs by treating malocclusions and occlusal alteration. However, in 1987 the infamous Brimm vs Malloy Michigan lawsuit case unfortunately not only cost the affected Orthodontist very dearly but jolted the whole Orthodontic community heavily which may be considered as The Turning Point in the subject [4]. This led to the original research in TMD by AAO for the first time [5] and the results can be summarised as

- No Significant relations between dental & skeletal structures with TMD
- Development of TMD cannot be predicted
- No available method of TMD prevention
- Usually initiates in adolescence but no relation to orthodontic Rx
- Orthodontic treatment per se don't cause TMD
- Orthodontics may help in lessening TMD symptoms
- Once TMD is present, its cure not assured

The above findings soon were reinforced by a study [6] of well-known experts in the field of Orthodontics and TMD with the following observations

- Signs & Symptoms of TMD may occur in healthy individuals
- Occurrence of TMD increase with age particularly during adolescence.
- Orthodontic treatment performed during adolescence generally does not increase or decrease the chances of developing TMD later in life.
- Therapeutic Extraction of teeth does not increase the risk of developing TMD.
- No elevated risk for TMD associated with any particular type of orthodontic mechanics.
- An optimum stable occlusion should be reasonable orthodontic treatment goal
- No method of TMD prevention has been demonstrated.
- In presence of more severe TMD signs & symptoms, simple treatments can alleviate them in most patients.

Additionally, the most common static malocclusion conditions which were more prevalent in patients with TMDs i.e large overjet, minimal anterior overlap and anterior skeletal open bite, unilateral posterior crossbite, occlusal slides greater than 2 mm, and lack of firm posterior tooth contact, are now mostly considered as the result of condylar position in TMDs rather than cause of the disease [7]. The only two dynamic occlusal relations i.e a CR CO slide of more than 4-5 mm and a strong mediotrusive contacts are still a concern as predisposing occlusal factors for TMD. Both the conditions produce a considerable orthopedic instability in TMJ which may lead to muscle hyperactivity with articular disturbances and derangement [8].

3. The Dogma of Occlusal Based Model

Surprisingly, in spite of the above findings and changing evidence of etiology and management of TMDs from an occlusal based mechanistic model to a biopsychosocial model with current evidence like other chronic pain conditions, a recent Web-based study revealed that a considerable number of the existing Web sites attributed TMD to malocclusion, and recommended to treat permanent occlusal alterations to alleviate the symptoms [9]. Secondly numerous philosophies and schools of thought still exist that suggest non extraction, expansion, alternative or non-traditional orthodontics, jaw growth, certain occlusal schemes, condyle locations, and positioning techniques, all in the name of curing or preventing TMDs. However, the anecdotal idea that certain traditional orthodontic mechanics and procedures cause a posterior displacement of the mandibular condyles, which then leads to TMD, is not supported by the evidence [10]. And it is also now established that a patient's original relationship of the jaws with their teeth in MI (ensuring no dual bite present) appears to be the best physiological guide for diagnosis and management. The patient's original condyle-fossa relationship should be maintained as much as possible throughout the orthodontic process to maintain the orthopedic stability [11].

4. Transition of Medical Based Biopsychosocial Framework

Recent studies ranging from placebo studies to a 12-year series of large-scale clinical studies conducted at the beginning of the 21st century called the Orofacial Pain: Prospective Evaluation and Risk Assessment (OPPERA) have shifted the focus from a dental and mechanical-based model of TMD care to a biopsychosocial model of care [12]. The results implicated six single-nucleotide polymorphisms (SNPs) as risk factors for chronic TMD, while another six SNPs were associated with intermediate phenotypes for TMD. Additionally, the enzyme Catecholamine O Methyl Transferase (COMT) has been found to substantially influence pain sensitivity and TMD onset via adrenergic pathways. Females with high pain sensitivity haplotype causing decreased activity of COMT were found to have significantly increased pain tendency with development of TMD [13].

The heuristic model guiding the OPPERA study assumes that origin and clinical manifestation of TMD is governed by two global intermediate phenotypes psychological distress and pain amplification which in turn are influenced by both genetic factors and environmental influences [14]. These findings which have verified some implicated risk factors for TMD and refuted others, have reoriented the thinking and changed the traditional thought process to a large extent. At present cause and effect relationship between occlusion and TMD is highly limited and almost confined to few conditions which predispose orthopedic instability with excessive loading. Extent of effects from these conditions along with most common causative factors like trauma in its various forms, chronic unreleasing emotional stress and association of other comorbid systemic pain conditions however depends on the adaptability of the patient in form of a 'sensorimotor neuroplasticity' in brain which further is dependent on patients' genetic profile, hormonal factors, extent of orthopaedic instability and degree of abnormal masticatory loading. Furthermore, our understanding of how pain is perceived and processed and the emotional, cognitive, and behavioural factors that modulate the pain experience has changed. In understanding of the chronic pain, antidromic effects of central sensitization with its sensory, motor and autonomic manifestations in the body from any source of severe stress, trauma or an untreated deep pain input and the added concept of referred pain with hyperalgesia/allodynia has changed the outlook in diagnostic approach of a TMD patient.

5. Contemporary Diagnostic Approach

It is prudent now for an orthodontist to examine the TMJ region in detail to exclude any TMD problem even if subclinical. At a minimum, a screening evaluation for TMDs must be a component of the initial clinical examination process. Different forms of questionnaires have been proposed by several authors over the last decades.

However, the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) is the most validated and reliable set of instruments for a comprehensive examination of TMJ [15]. The screening tools with scoring guidelines available in www.rdc-tmdinternational.org The DC/TMD offers a standardised and operationalised method which encompasses physical examination of the masticatory structures (Axis I) and screening for psychosocial and comorbid factors (Axis II) to allow diagnosis of TMD. Out of 38 defined forms of TMD, Axis I describes 12 most common conditions having established sensitivity and specificity. These are further grouped as myalgia, arthralgia, intraarticular disorders and headache attributed to TMD. Axis II of the DC/TMD contains recommended instruments for screening and for a comprehensive assessment. These instruments aim to assess pain behaviours, psychological status and level of function.

Though TMDs generally follow a benign and non-progressive course, the orthodontist must also be aware of certain conditions which may mimic TMD in its clinical presentations but of urgent medical need with possibilities of malignancy and other serious conditions. These are designated as 'Red Flag' conditions [16].

6. Contemporary Awareness and Duties of Orthodontist for A TMD Patient [16]

1. Keep updated for latest developments
2. Orthodontics in general is TMD "neutral," it neither causes nor cures (or mitigates) TMD
3. Early orthodontic treatment doesn't prevent development of TMD in future
4. There is also no evidence that asymptomatic individuals with intracapsular disorders are more prone to develop TMD in the future
5. Not all patients with growth deficiencies have these disorders and not all growing patients with disc disorders grow abnormally
6. Avoid diagnosing and treating TMD in framework of traditional occlusal based model
7. Comprehensive clinical examination of TMD with current guidelines
8. Inform the patient of any notable findings and possible consequences and prognosis
9. Orthodontists need to differentiate between major and minor signs and symptoms of TMD if they are discovered during the screening.
10. Educate the patient of possible arise of TMD symptoms during or after orthodontic treatment
11. Documentation of all relevant findings
12. Treat symptoms before orthodontic procedure and referral to a specialist if required
13. In case TMD symptoms arise during treatment, stop all active orthodontic treatment and manage TMD pain with current guidelines
14. It is recommended to manage TMDs with conservative, palliative and reversible therapies at least in initial stages. Even role of placebo therapies in form of sham medication, mock equilibration and non-occluding splints shouldn't be ignored which have been shown to be quite effective [17].

7. Conclusion

The traditional occlusal based paradigm has been changed to a broader biopsychosocial model to understand TMDs with an evidence and scientific base research instead of relying on opinions and anecdotes. Trauma and Stress play a vital role in initiating and perpetuating TMD symptoms and role of occlusal abnormalities are limited as par current evidence. Genetic and epigenetic blue print of patient determines the degree of adaptability to a causative factor for TMD. The orthodontist needs to examine a patient with a contemporary diagnostic guideline for the whole masticatory apparatus as well as cervical musculature to identify potential intracapsular or extracapsular disorders.

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Aligner Treatment - My Mistakes and My Learning Curve

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ABSTRACT

In the meantime, an ever increasing number of patients are being treated with aligners. Usually, we are treating our patients successfully. However, mistakes lure anywhere. On one hand, the laws of biology and of biomechanics cannot simply be ruled out by aligners. On the other hand, treating with aligners is technically very much different from treating with multiband appliances. This communication shares my experience, my errors and highlights some paramount aspects

Keywords: Aligner Treatment, Mistakes, Counteractions, Unwanted effects.

1. Introduction

Because of their philosophy [3], easier handling and the possibility to plan the treatment digitally in advance, I like the use of the aligners better than the tinkering with the multibracket system. In addition, there is the better acceptance by the patients, the aesthetic appearance and the better caries-protectivity.

At the time of the introduction of the Invisalign system in 2000 [6], I only treated very simple cases with aligners, so I only trusted the system to perform really very modest tooth movements. Ten years later, I had already treated about 50 of my patients with aligners but I used the multibracket system, which orthodontists of my age have mastered on their fingertips for decades, for the more complex tasks. And presently, in 2023, almost 95% of my patients are being treated with aligner systems. Not only adults, but an increasing number of adolescents also.

2. Peculiarities and Sources of Error

With the aligner system, of course, you have to rethink orthodontics a bit. It is a shape driven technique where the forces are being generated by the splint bending itself against the malaligned teeth [1, 7, 9]. It lacks the rigid guidance provided by the continuous arch in the multibracket technique. Therefore, the geometric effects of the roots in the alveolar socket must be taken into account even more [9]. Unwanted extrusions can thus be almost anticipated (Fig. 1), but unpredictable rotations and/or intrusions [5] also do occur despite the well designed attachments (Fig. 2). Of course, this must be counteracted with additional force systems generated by forming elements such as bite ramps or with suitable elastics (Fig.3). Aligners are indeed much less effective without attachments - but prospective tooth movement must be included in planning their placement to avoid traumatic pre-contact against the attachments during the course of treatment (Figs 4a, b). We know that intrusion of the posterior teeth [8] can occur during aligner treatment intrusive forces are built up due to the material thickness when the patient bites close (Fig. 5a). Therefore, class-II elastics (which, after all, vectorially have a vertically extrusive force component) or even specifically vertically acting elastics are almost always included and prescribed (Figs 5b, c). Even if it is not always immediately obvious in the simulation with computer algorithms: With aligners, you can only predictably aim for your results if you create secure anchorage (skeletally, as in Fig. 6a), or you make clever use of reciprocally acting force systems. (Fig. 6b). And, of course, it is always helpful if you have mastered the multibracket technique so well that you can also use it to perform individual tasks in addition to the aligner splints when these reach their technical limits (Figs 7a-f). And even if the patient does not want it: I almost never treat in only one arch anymore - it is important to be able to compensate the side effects (as in Fig. 8) in the opposing jaw right away.

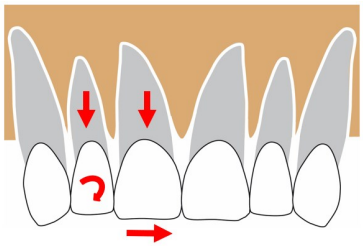

Fig 1. Schematic illustration of unwanted side effect forces. A translation of the upper central incisor towards the midline may create extrusive forces due to the conic shape of the alveolar socket. A rotation of the upper lateral incisor may create extrusive forces because of the resulting incongruence between the root form and the shape of the alveolar socket.

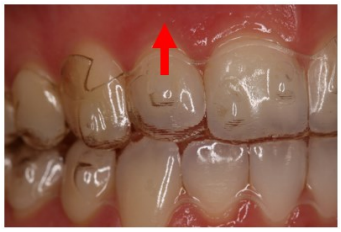

Fig 2. Unwanted intrusion, or failure of extrusion is not rarely observed for the upper lateral incisor.

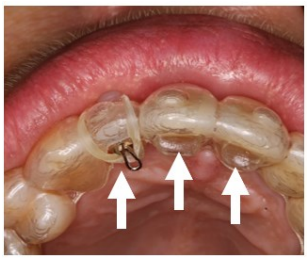

Fig 3. Failure of extrusion or unwanted intrusion of the lateral incisor may be solved with a "boot-strap" design of elastics (arrow at lateral incisor). Extrusion may be counteracted or active intrusion may result from bite ramps (arrows a central incisors).

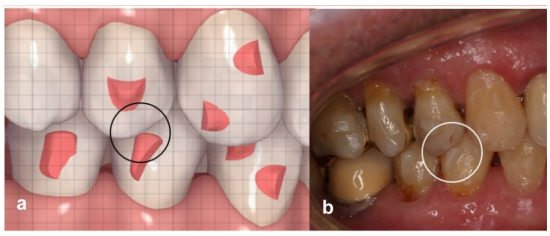

Fig 4. Any interference between attachments must be avoided (a). Even though it may not bother the patient while wearing the aligners, a traumatic contact will result when the aligners are taken out (b).

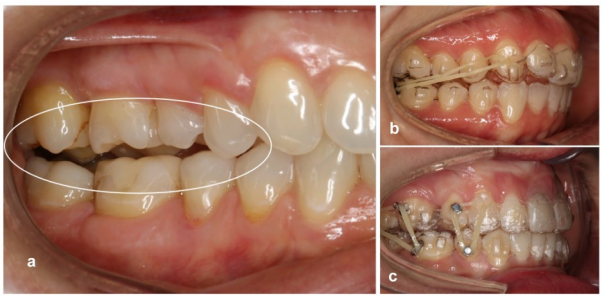

Fig 5. A known side effect of splints of any type is the intrusion of the teeth by the thickness of the material (a). This must be actively counteracted with Class-II-elastics (b) or, more specifically, with vertical elastics (c).

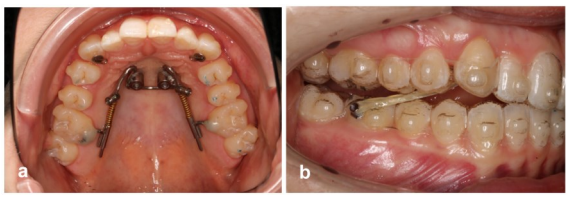

Fig 6. Secure anchorage for aligner systems are bone-supported auxiliaries, such as e. g. the Beneslider (a). Wisely planned reciprocal force systems (b) can also provide effective anchorage.

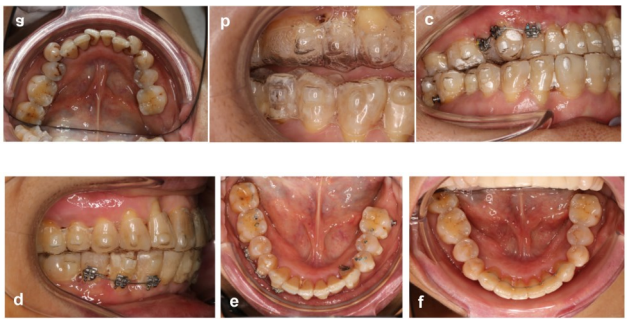

Fig 7. A highly pronounced crowding with buccal and lingual tilting of the premolars (a) can present a mechanical challenge for the aligner material: The aligner will lift off (b) and fails to fully develop the programmed force system. In this case, it is helpful to be familiar with the multibracket technique (c), with which partial shaping of the dental arch can be achieved in a more targeted manner at times (c, d, e). Afterwards, further finishing can be carried out with aligners (f).

Fig 8. If aligners are only used in the lower jaw, one must expect unwanted side effects in the upper dental arch, such as the undesirable development of a medial diastema in this case.

Conclusion

Although there are always studies in the literature that cast doubt on the efficacy of the aligner technique [2. 4], the important aspect is to recognize its technical weakness and take appropriate countermeasures in a targeted manner. These are all not even considering in some of the studies. If you are smart and vigilant and learn from your own mistake, you will get a very steep learning curve with aligners and be able to treat successfully.

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Orthodontic Diagnosis in the age of AI: A Revolutionary Evolution

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The field of orthodontics is on the cusp of a major transformation with the advent of AIdriven orthodontic diagnosis. Artificial intelligence has the potential to revolutionize the way orthodontic patients are diagnosed and treated by streamlining diagnostic capabilities and improving treatment planning.

The rise of digital orthodontics has enabled us to seamlessly transition from 2D to 3D diagnosis modalities, merging 2D-3D data to formulate appropriate treatment plans and plan alternatives. However, the AI revolution requires the gathering of large quantities of data to be processed, known as "BIG DATA." Once processed through AI machine learning, this data has the potential to improve the capabilities of the medical field in diagnosis and treatment planning, as well as the prediction and recognition of diseases.

The traditional orthodontic diagnostic model relies heavily on the subjective experience of treating orthodontists, and treatment outcomes are not used as feedback mechanisms to improve future outcomes in any truly objective way.

In contrast, AI-driven deep learning models process huge datasets from multiple patient observations to create predictive treatment models and probable outcomes. The system continuously feeds itself this data, strengthening or weakening the various probabilities it manages to predict, much like how the brain strengthens its neuronal memory networks over time. Over time, with more and more data being introduced, the potential for outcome prediction can increase exponentially, leading to consistently improved treatment predictions and outcomes.

There are two basic methods to train a neural network: Supervised and Unsupervised learning. Supervised Learning involves creating rules or activation functions based on a segment of the dataset and training the AI network until a satisfactory output is reached. This is the most common form of training orthodontic algorithms at the moment.

Unsupervised Learning is based on the principles of back propagation based on the German mathematician Carl Gustav Jacobi's principle of "beginning with the end in mind" and gradient descent (error analysis) to fine-tune the results, and is based on feeding a large dataset of "before and after" treatment "inputs" into the neural network without specific rules or instructions.

The question remains whether AI will ultimately benefit or curse the profession. As we move towards Orthodontics 4.0, it is important to keep in mind what Prof. Jean-Marc Retrouvey recently outlined; that AI algorithms are future tools, and the future of orthodontic practice may be dependent on a digital system with orthodontists codeveloping neural algorithms with orthodontic companies to improve efficiency in diagnosis, treatment planning, and overall improved outcomes.

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Benefits of the Aligner Treatment in Young Children and Teenagers

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Clear aligners are plastic replicas of patients' teeth. Wearing them puts gentle pressure on teeth, ever-so-slightly repositioning them. In comparison to classic fixed braces, comfort of the patient is improved, less appointments at orthodontist are needed and less acute appointments occur. Clear aligner therapy requires less chair time, which is beneficial for the patient but also requires a lot of precise digital planning for the orthodontist. My aim was to show clinical cases of young children and teenagers with various malocclusions treated with clear aligners and to demonstrate treatment plans and biomechanics I use in my digital treatment planning to achieve predictable and stable results.

Starting orthodontic treatment at an early age may be of great importance in some malocclusion. Developing dental arches, correcting crossbites or creating space for permanent teeth may reduce the need for complex orthodontic treatments in future.

In my presentation I explained how I use clear aligners in the first phase of treatment in young children with different malocclusions. In my experience this treatment is very well accepted from our young patients from 6 to 10 years old, with ongoing or finished first phase of eruption of permanent teeth, and their parents. This treatment usually takes 12, maximum 18 months.

The treatment goal for the first phase of treatment is adequate development of the arches by expansion in both upper and lower arch. With development of the arches it is necessary to carefully plan sufficient space for unerupted teeth to achieve smooth replacement of primary teeth. Planning extra space around primary canines is beneficial in the second phase of eruption of the permanent teeth. If anterior or posterior crossbite is present it needs to be solved at the early stages of the interceptive treatment. The thickness of aligners and occlusal attachments on the molars to help to disocclude the arches. The first phase of the treatment is finished with well aligned upper and lower central and lateral incisors, midlines centered, vertical and sagittal dental parameters corrected and first molars ideally in Class I relationship. Then a pause in the treatment follows with careful observation of the eruption process of all unerupted teeth and skeletal growth of the patients and if it is necessary, a second phase of the treatment is planned, which is usually short and uncomplicated thanks to the well planned first phase of the treatment.

Later in the presentation I demonstrated a complex treatment of various combinations of transversal, vertical and sagittal discrepancies in teenage patients up to 19 years. It is now possible to treat with aligners also patients with agenesis and decide for a space closure or space opening treatment plan as both of these options are manageable by clear aligner treatment. Average treatment duration with clear aligners in teenage patients is 18 to 24 months depending on the severity of malocclusion and compliance of the patient. An orthodontic treatment in these cases starts in late mixed or permanent dentition.

Special part of my presentation was dedicated to Class II treatment in growing patients. It is the most frequent sagittal problem in orthodontics, as it affects one- third of the population [1]. In the Slovak population this number is even higher and a high percentage of my patients come to my office with this skeletal relationship of dental arches. In my lecture I compared current available treatment options of Class II in orthodontics and focused on different options with clear aligners. Patient treated with extraction of 2 premolars in the upper arch has been demonstrated, but also several growing patients with Class II subdivision 1 or subdivision 2 treated with clear aligners, where the treatment plan was to modify growth of their mandible and shift it forward either with Class II elastics or mandibular advancement.

Standard protocol for Class II elastics I use is precision hooks on upper canines, unless ectopically erupted, and button cutouts on lower first permanent molars. From clinical experience I highly recommend placing button cutout distally on the molar and combining it with rectangular horizontal attachment mesially. Class II elastics combined with clear aligners and fixed multibrackets produce a similar correction on sagittal discrepancies in growing patients. In part of my research I conducted in 2021 clear aligners presented a better control in proclination of the lower incisors. Clear aligners and elastics might be a good alternative in the correction of mild Class II malocclusions in cases where a proclination of lower incisors is unwanted [2].

Both from the clinical experience and the research carried out recently it is now confirmed that patients treated with clear aligners have significantly better gingival health, whereas oral hygiene is not different between patients treated with fixed orthodontic appliances and clear aligners. Clear aligners are more gentle for gingival tissue due to more simple oral hygiene [3]. If patients develop gingivitis, they may be at risk of developing periodontitis when not diagnosed preemptively, which consequently leads to loss of connective tissue, destruction of bone support and tooth loss [4]. This is one of the main objectives we consider, together with parents of adolescent patients, when choosing the best treatment option and orthodontic appliance for them.

Aligner therapy has become in the last years preferred treatment option for young children and teenage patients, as we are now able to treat almost any malocclusion with clear aligners. With understanding the unique biomechanics of clear aligners, carefully following treatment protocols and taking advantage of auxiliaries, such as temporary anchorage devices, even previously less predictable diagnosis and symptoms are becoming nowadays easier to manage.

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Enamel Homeostasis in Orthodontic Treatment

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While the focus of orthodontic treatment is on desirable dentofacial outcomes, very often clinicians overlook the residual effect of orthodontic appliances on the enamel. These can be:

- White Spot lesions
- Change in colour /stains and pencil marks
- Change in surface roughness & loss of gloss
- Attrition and abrasion
- Tear outs /cracks

White spot lesions (WSL) are areas of subsurface enamel porosity due decalcification and they appear white due to increase backscatter of light and varying refractive index as compared to normal enamel. The presence of orthodontic appliances in the mouth changes the quantum, composition and pH of the oral biofilm with increased colonization of cariogenic microorganisms particularly Streptococcus Mutans.[1]

Fluoride in various forms is an obvious choice to prevent the occurance of WSL but its effect is variable based on the pH of the plaque. Thus other methods have been advocated to WSLs such as CPP-ACP, bioactive glass, probiotics, low metabolite chewing gums. [2] Nanotechnology which involves the incorporation of nanomaterials in materials or coating the surface of orthodontic appliances to inhibit cariogenic microorganisms have also shown promise although they are yet to be utilized in routine clinical practice. [3]

Fluoride varnishes applied routinely, atleast once a month seem to be the best choice for high risk patients although there is some evidence to show that CPP-ACP and bioactive glasses have their uses.

At debonding , mild WSLs can be managed with natural remineralization or low dose fluorides. High dose fluorides have the risk of hypermineralizing only the superficial layer and causing permanent change in colour. For more distinct reasons, Microabrasion , Resin infiltration and bleaching are possible options. More severe lesions with cavitation have to be managed with restorations.

Prevention	**Control of early WSLs**	**Management**
Maintenance of good oral hygiene Fluoride toothpaste / mouthwash / varnish Probiotics -Dentifrices, lozenges and probiotic foods Xylitol chewing gum Use of fluoride releasing orthodontic adhesive Nanotechnology	Fluoride varnish Xylitol chewing gum Bioactive glasses CPP-ACP	**Mild** Natural remineralization Low dose fluorides CPP-ACP Bioactive glasses Xylitol chewing gum **Moderate to severe** Bleaching Microabrasion Resin infiltration Restorations

The placement and debonding of orthodontic appliances can cause injury to the enamel. One issue of major concern to the patient is the change in colour. This occurs due to etching of the enamel, the composite microtags left behind after debonding, endogenous and exogenous changes in the tags and alteration to the surface texture and smoothness of the enamel. Care must be taken to avoid enamel cracks and tear outs during debonding. Loss of gloss is also something that happens with fixed appliances.

It has best that debonding is done with the failure at the bracket adhesive interface with excess composite removed with Tungstan carbide burs that are recommended in preference to other rotary instruments. Polishing with sof-lex discs or composite finishing burs is mandatory and helps in the regaining of enamel colour and smoothness.

Highlights

- 50% of patients will develop a WSL;Maxillary anteriors are highly susceptible
- Routine oral hygiene instructions and fluoride containing toothpaste are inadequate
- Fluoride varnishes atleast every 1-3 months are necessary to be effective
- CPP-ACP and bioactive glass are viable options
- Self etch primers and RMGICS are kinder to the enamel
- Removal of excess composite with a TC bur is highly recommended
- Polishing is mandatory and helps recover colour loss
- Resin infiltration shows some promise in treating white spot lesions
- Nanotechnology may offer solutions in the future

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Converting Digital Imaging and Communications in Medicine (DICOM) File from CBCT to Stereolithography (STL) File using Materialise Mimics Software for Estimating Alveolar Cleft Volume in Unilateral Complete Cleft Lip and Palate

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ABSTRACT

Aim

To convert DICOM file from CBCT to STL file using Materialise Mimics software for estimating alveolar cleft volume in UCCLP.

Materials & Methods

Pre-surgical CBCT images of eleven UCCLP patients were included. Estimation of alveolar cleft volume using computer simulation (Mimics) software was performed by converting Digital imaging and communications in medicine (DICOM) file to stereolithography (STL) file using Materialise Mimics software. Superior, inferior, lateral, medial, posterior and anterior borders of the alveolar cleft were constructed using specific anatomical references. Alveolar cleft mass was created by erasing outside mass by using edit mask tool. Only mass volume within alveolar cleft remained. Contour editing tool in the Mimics software was used to smoothen the borders of alveolar cleft. Volumetric assessment function in Mimics software was adopted to measure volume of 3D virtual model of alveolar cleft constructed from CBCT images.

Results

There were 6 females and 5 males with mean age of 11.64 years (ranged from 8.58 to 22.92 years). Mean and standard deviation of alveolar cleft volume in UCCLP was 1.21 ± 0.28 ml (ranged from 0.85 to 1.80 ml).

Conclusion

Alveolar cleft volume in UCCLP might be accurately measured using pre-surgical CBCT and computer simulation (Mimics) software. Further investigations pertaining to comparisons of calculated alveolar cleft volume using CBCT and actual graft volume should be performed.

Sagittal Mandibular Distraction Osteogenesis

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ABSTRACT

Severe Class II cases requiring surgical treatment fall into two main categories. Either the mandible is backward positioned or the corpus part of the mandible is short. Previously treatment involved BSSO in both cases with extraction in the latter one. Distraction osteogenesis is a biologic process of new bone formation between the surfaces of bone segments that are gradually separated by incremental traction. Interdental corpus distraction based on this principle and distraction histiogenesis allows the treatment of short mandibular body without extraction of teeth, creating the space within the arch and at the same time correcting the skeletal anomaly and the profile of the patient. The aim of the lecture is to present this technique and show cases where this has been used successfully.

Efficacy of Clear Aligners - the Importance of Physical and Mechanical Properties of the Aligner Material

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Clear Aligners have become popular in the field of Orthodontics as it satisfies the aesthetic appeal of most of the orthodontic patients. Apart from being an invisible appliance it also has certain advantages like less irritation to the intra oral soft tissues and is also associated with reduced incidence of white spot lesions as compared to the conventional fixed appliance. Despite the advantages the clear aligners are to found to be less efficacious as compared to fixed orthodontic appliance interms of the occlusal outcome. The discrepancy between the achieved outcome and the predicted outcome is found to be greater with clear aligners. The most important reason attributed to the rapid force decay observed with clear aligners. The force exerted by any orthodontic appliance is inturn influenced by the physical and mechanical properties of the materials it is made of.

This presentation is a systematic review of the physical and mechanical properties of various clear aligner in as received state and after time bound usage .

Twenty Four articles were selected after a search from five electronic databases and hand search. Out of the 24 articles, 19 and 23 articles evaluated physical properties and mechanical properties respectively. The physical properties studied were transparency, Hardness, glass transition temperature, surface roughness and water absorption. The mechanical properties that were assessed included stiffness, yield strength, tensile strength , stress relaxation behaviour and creep behaviour. The results showed that PETG based materials are more transparent as compared to polyurethane. Polyurethane based materials were found to have the highest hardness and stiffness but the at the same time demonstrated the highest creep behaviour, and higher stress relaxation behaviour. The hardness and stiffness of PETG based materials were inferior to polyurethane based materials and it demonstrated the highest stress relaxation behaviour. Materials like polypropylene. though superior in stress relaxation behaviour but had reduced hardness and stiffness as compared to Polyurethane and PETG.

The material properties were found to deteriorate with intra oral use and thermocycling. The results also showed increased water absorption with time in all the materials. With the findings of the review we could clearly appreciate the need for improvement in the properties of clear aligner materials to improve its clinical efficacy.

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