

LIFESTYLE

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Relationship Between the
World's Beloved
Beverage & Health

Surgical Therapeutic Modalities of Peri-Implantitis

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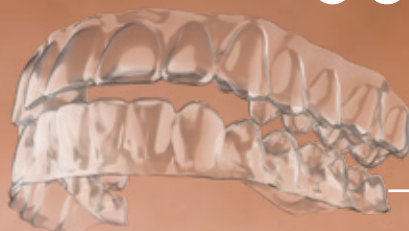
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SUCCESS, FAILURE & THE IMPLANT PATIENT:

What have we learned from
20 years of PROs research

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Effect of Trimming Line
Design and Edge Extension of
Orthodontic Aligners on Force
Transmission: An in Vitro Study



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What Is **DENTAL DIARIES?**

Practicing dentistry at the highest standards today is a challenge. As dentists we have to stay on top of a rapidly changing science, decide among growing technological innovations and new products and serve patients with ever changing needs and expectations. All these, while striving to maintain work-life balance in difficult times for all can be tough and it is no surprise that dentistry is among the most stressful professions.



At the Dental Diaries, we aspire to support dentists of Hong Kong and Macau on every step. Every quarter, our editorial team will gather the most up-to-date news in the dental field, short scientific articles and case studies, together with lifestyle information, suggestions and ideas to balance a busy working life with some fulfilling personal time. We also want to foster a network, by sharing messages, news and classified ads for the local dental community.

We hope that every time you receive the latest Dental Diaries, you will not only gain professional knowledge, but it would also make your break a little bit more relaxing!

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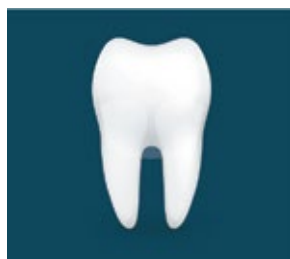
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SUCCESS, FAILURE & THE IMPLANT PATIENT:

What have we learned from 20 years of PROs research



Prof. Nikos Mattheos
DDS, MASC, PHD

“

Success is a matter of definition; and when it comes to implant dentistry we have developed some complex criteria to assess it. But do patients understand implants the same way we do? What do they expect and what is it that makes them satisfied or unhappy? Patient Reported Outcomes or PROs covers a wide field of research, helping us understand what patients experience when under medical care and thus deliver better treatments and reach better outcomes. In the case of implant dentistry, this has taught us some invaluable lessons on how to design treatments, how to proceed - and even more importantly when to not proceed with implant treatment.

The journey of the implant patient is a long one, as it usually starts long before we meet them for an assessment or implant consultation. For many of them started long time before, diagnosed with periodontitis, then continued with different stages of treatment with active interventions possibly interchanged with phases of maintenance therapy, with a final stage of losing one or more teeth. For others it might have been a shorter journey, having received a late diagnosis of advanced conditions that warrants implant placement, while others might reach us after a long period with missing teeth, having recently for some reason opted for a replacement. In any case, implant rehabilitation aims to restore function and aesthetics, but also support all psychosocial aspects of a healthy and stable dentition. But as every patient's journey is different, everyone will come to your chair with different luggage and putting these luggage through your x-rays might be as important as the actual oral radiographs for a successful treatment planning. The patients behavioural background, including their self-perceived condition and needs, their expectations and understanding of implant therapy could significantly influence their perception of the treatment outcome and consequently the success of the implant therapy. Recently, certain psychological disorders have also been shown to pose great risks for implant therapy. Finally, the patients' journey might be further perplexed by a diagnosis of peri-implantitis, which could come with significant behavioural implications, while its management would require the full patient engagement and participation. The dentist is not a psychologist; yet so much of our treatment success depends also on behavioural understanding and intervention, that we cannot afford to miss out. Luckily a whole new direction of research has been developed to help us out, involving a wide array of studies under the name Patient Reported Outcomes/Experience (PROs/PRE).

Assessing patient reported outcomes / experience - concepts and instruments

Understanding patients' perceptions, values and viewpoints is one of the three essential components of evidence-based medicine [Sackett et al, 1996] and is a critical parameter for assessing treatment needs, planning suitable therapies, and ultimately, reaching a positive clinical result. The concept of Oral Health-Related Quality of Life [OHRQoL] was developed to evaluate the impact of oral disease, as experienced by the patient. Thereafter, several instruments have been developed to assess the impact of disease or treatment interventions on patients' satisfaction, experience and self-perceived quality of life. Despite its documented value, as well as increased popularity in research, instruments to record PROs and PRE have been almost exclusively developed for clinical trials with large number of patients. The use of such instruments however outside research settings, e.g. with individual patients in day-to-day care might be of little benefit or relevance. Simple statements formed as "agree-disagree" visual analogue scales have been proposed by some authors as means to "screen" patients with misperceptions, but even in such cases the appropriate remediation follows with different forms of personal communication [Figure 1].

Statements:

- Dental Implants are a well-tested and documented treatment for replacement of missing teeth**
I disagree |-----| I agree
- Treatments with Dental Implants have no risks or complications**
I disagree |-----| I agree
- Dental implants are as functional as natural teeth.**
I disagree |-----| I agree
- Dental Implants look as nice as natural teeth**
I disagree |-----| I agree
- Dental Implants require less care than natural teeth**
I disagree |-----| I agree
- Dental Implants last longer than natural teeth**
I disagree |-----| I agree
- Dental Implants is a treatment appropriate for everyone**
I disagree |-----| I agree

Figure 1. Seven statements recommended for screening expectations and perceptions of patients candidates for implant therapy, based on an instrument validated by Yao et al 2016. Statements are included in the medical history self-declaration of the patient, who are instructed to place a mark in the VAS to indicate agreement or disagreement as follows: "A mark right of the middle line indicates agreement, a mark left of the middle line indicates disagreement. The higher your certainty to agree/ disagree the closer your mark to the respective end of the line. If you are uncertain place the mark in the middle".

◆ How to assess patients' behavioural background before implant placement?

Key self-reported parameters which have been shown to potentially influence treatment success include expectations, perceptions [Yao et al 2014, Sermsiripoca et al 2021], attitudes [Yao et al 2017, Korfage et al, 2018], anxiety [Abrahamsson et al, 2017], and personality traits [Abu Hantash et al, 2006]. Among the five dimensions of personality [neuroticism, extraversion, openness, agreeableness, and conscientiousness], neuroticism was the trait reversely associated with overall satisfaction after implant treatment.

Despite the increasing emphasis on the role of expectations and perceptions as part of assessing the candidate for implant therapy [Yao et al 2014], measures related to patient-reported expectations have been little studied and scarcely reported. A frequently overlooked but important starting point to understand a patient's expectations and gradually build the appropriate communication strategy is the patients' chief complaint. Patients who include implant-related expectations in their chief complaint, might present a clearer goal and tend to be more prepared for discussion about the treatment.

Yao et al 2017, Sermsiripoca et al 2021 and Vipattanaporn et al 2019 developed and utilized questionnaires to assess patients' expectations and perceptions. Although these instruments were of different levels of complexity reflecting the needs of research, the authors suggested that simplified segments of the questionnaires were well suited to serve day-to-day practice as well. This consisted of simple statements to which the patient was invited to agree or disagree with, also registering the extent of agreement/disagreement on a VAS (Figure 1). By recording the patients' extent of agreement/disagreement of such statements during the medical history documentation, researchers reported they were able to "flag" patients with misperceptions and over expectations and consequently attempt to manage them accordingly with remedial discussion. From the same studies emerged that more than 30% of the sample appeared to maintain dangerous misperceptions typically overestimating dental implants longevity and underestimating risks and the need for maintenance care [Yao et al 2017], while some of the misperceptions were found to be maintained even after the completion of the treatment [Sermsiripoca et al 2021]. This might be not surprising given the fact that clinicians have been shown to be sometimes reluctant to voluntarily offer information about the longevity/ lifespan of dental implants and might have different opinions regarding the timing of information related long-term maintenance needs [Kashbour et al 2018].

◆ Special considerations for patients with behavioral disorders

Implant therapy becomes increasingly complicated if the patient is under certain behavioural disorders that might influence his ability to understand the treatment implications and thus to offer informed consent. One such disorder which even more is likely to reach the dentist undiagnosed is the Body Dysmorphic Disorder (BDD), which evolves from preoccupation with an imagined defect or flaw in physical appearance that cannot be observed or appears slight to others. It is often referred to as disease of “imagined body ugliness” and its reported prevalence is between 1.7 – 2.4% of the population globally [Al Shuhayb et al 2023] but can rise up to 32.7% among patients seeking cosmetic surgical procedures [Nabavizadeh et al 2023]. BDD can be a serious long-term disorder and has significant comorbidities such as depression, obsessive compulsive disorder and suicidality. Teeth and smile are the 3rd most common body part that BDD patients focus on, after nose and skin. Thus, the dentist is a frequent first recipient of such patients [James et al 2019], especially if perceived to specialise or offer invasive cosmetic procedures such as correction of “gummy” smile or similar. Such patients will not show direct signs of cognitive or behavioural impairment, with the only warning sign at times being a seemingly excessive preoccupation with specific aesthetic features. Being aware of BDD is the first critical step for a dentist to recognize or suspect such condition in their patients. Asking simple open-ended questions might be helpful, such as “how much time do you spend worrying about your appearance?” As rough approximation about half of BDD patient spend on average 3 hours per day ruminating about looks [Bjornsson et al, 2010], and many patients spend most of their waking time doing this. It is highly advisable to not proceed with periodontal plastic or implant surgery in patients suspected of having BDD without ensuring professional psychological assessment and, if needed, support.

◆ How aware are peri-implantitis patients of their condition?

Patients' awareness of peri-implantitis is limited. Cross sectional studies have shown inability of patients to differentiate at large between healthy implants and those affected by peri-implantitis, even when they can see the respective implants in the mirror [Romandini & Lima 2021]. When it comes to biological and technical complications it has been shown that the ones impacting patients' quality of life are the complications affecting chewing ability [Esteve-Pardo et al 2023]. It appears that for many of the implant patients, the first time they hear of peri-implantitis is when they get diagnosed with it, a situation which sometimes leads to a deleterious cascade of emotional reactions, resulting in disappointment, resentment, and loss of trust to the therapy and the caregivers [Abrahamsson et al 2017].

◆ How to best remediate for patient's misunderstandings and misconceptions about implant therapy?

“What you say before treatment is an explanation, what you say after is an excuse”, a statement that is particularly true when it comes to dealing with implant patients. At a diagnostic stage we have to assess patients' expectations and perceptions as part of our standard clinical assessment and if unrealistic expectations or misperceptions are identified, to remediate accordingly. In most cases this implies proper patient education. Patients' education has been attempted in many ways and with different levels of success, from books, notes, resources and phone apps to multimedia and websites. Nevertheless, the face-to-face patient to doctor open ended communication, remains an essential part of diagnostic and therapeutic practice and still, probably the most effective way to comprehensively assess PROs and PREs in day-to-day clinical care settings. Taking time to listen to what patients have to say and asking questions with focus on emotional issues, establishing rapport and building a “therapeutic alliance” remains invaluable in understanding the individual patient and its perspective in day-to-day practice.

Conclusions

Instruments assessing PROs and PREs are increasingly valuable to document the impact of implant treatment on patients' quality of life, but also to offer a deeper insight to the clinician of important behavioural patient traits and perceptions. Patients' expectations and perceptions can interfere with the treatment success, both as it is defined by the clinician as well as the patients' own perceived success and satisfaction. Unrealistic expectations, lack of comprehensive awareness of maintenance needs, limitations and risks is a major threat to the long-term success of implant therapy, thus a behavioural assessment is essential part of diagnosis and treatment planning procedures of the patient candidate for implant therapy. Despite its potentially detrimental effects, patients are largely unaware of peri-implantitis because most cases present asymptotically. Thus, it is not uncommon that many patients find out the problems related to peri-implantitis only after they are diagnosed with it, leading to feelings of disappointment and loss of trust to the treatment and the care givers. The clinicians will have to commit to significant effort to establish a “therapeutic alliance” with such patients and successfully lead the treatment processes with them as a shared responsibility.



Experimenting with Patients' Education Booklets

Having experimented for a decade with patients' education in the Implant Dentistry programme, we started with a 56 pages patient book compiled by a major international implant association. The patient education booklet included 56 questions and answers, but we soon found out that most patients, although welcomed the booklet did not appear to actually read all this information. We then decided to develop our own booklet a much shorter one with only 12 questions/answers based on the most common misconceptions our patients had presented with (Figure 2, 2a,b,c).

We further made this booklet available in English and traditional/simplified Chinese. We found that the short booklet was much more effective than the lengthy ones. The same booklet was then translated in Thai language and used at Chulalongkorn University in Bangkok, where we received the feedback that the patients did not seem able or eager to relate to some of the clinical images. In response, we removed all clinical images/ radiographs and replaced them with artistic representations aiming to foster an emotional response rather than focus on graphic details of the anatomy and the treatment. The upgraded booklet with the artistic representations proved to be a hit with the patients (Figure 3, 3a,b,c). In the end however it was clear that no matter how well designed or popular

booklets have certain limitations. Patients often perceive the information in such booklets as "generic" and fail to see how it relates to their own, specific situation. Consequently they tend to miss important aspects, even after having read the provided booklets. Such "pre-compiled" information is important to set the stage and prepare the patients understanding, but the need remains for individualised, face-to-face, in depth discussion. Taking time to listen to what patients have to say and asking questions with focus on emotional issues, establishing rapport and building a "therapeutic alliance" remains invaluable in understanding the individual patient and preparing them for a successful and long lasting implant treatment.

You can download the patients' booklet in pdf format at: <https://mattheos.net/resources/> under section "patient education".

Download the patients' booklet >



Figure.2a

1. What is a dental implant?

Dental implant is a treatment option for replacing missing teeth. A dental implant is like a screw, usually made from titanium. It mimics the root of the natural tooth. Complete treatment involves two phases: the **surgical phase** (placement of the dental implant) and the **prosthetic phase** (placement of teeth on implants).

During a small surgery (usually under local anesthesia) the dental implant is placed in the bone of the jaw, where it remains undisturbed for a period of 6-24 weeks. The implant is either not visible during this period or only the top of the implant is visible. In this period, the bone grows in tight contact with the dental implant, an event we call "osseointegration".

After osseointegration is achieved, the implant is restored with a metal or ceramic abutment which can be used to support a crown, a bridge or another dental prosthesis which replaces one or more missing teeth. This is the prosthetic restoration.



Figure 1. (1) Teeth (2) Implant (3) Crown



Figure 2. The implant is either not visible during the healing period or only the top of the implant is visible



Figure 3. Implant with abutment and abutment screw

Figure.2b

2. Which are the main treatment options for replacing the missing teeth?

There are several options for replacing missing teeth. Each treatment option has its own indications and contraindications.

Implants

Implants can be placed in the area where the teeth are missing. Then single crowns or a bridge can be fixed on to the implants. Implants can replace single or multiple teeth, or support prosthesis for people who have no teeth at all.



Figure 4. Implant supported single crown



Figure 5. Implant supported bridge



Figure 6-8. Implant supported full arch prosthesis

Figure.2c

3. Are dental implants safe?

Dental implants have been in use for more than 30 years and have been proven safe and effective at replacing missing teeth. Millions of people have benefited from treatment with dental implants, while today we achieve osseointegration in more than 98% of the implants placed.

Allergic reactions or rejections of the dental implant are very rare. Titanium is one of the most tissue-accepted metals, and has negligible metal toxicity.

Nevertheless, placement of the dental implants requires a surgical intervention, which might be contraindicated in patients with certain health conditions or medications.

Implant surgery however, like every surgical procedure can have complications. Depending on the **local anatomy and proximity to sensitive structures (e.g. nerves, arteries, veins)** careful planning is required and often detailed **radiographic examinations** in order to prevent injury of sensitive structures. Your dentist will discuss with you in detail if any risks exist in your case.



Figure 10. Local anatomy which is sensitive to implant surgery

Figure.2

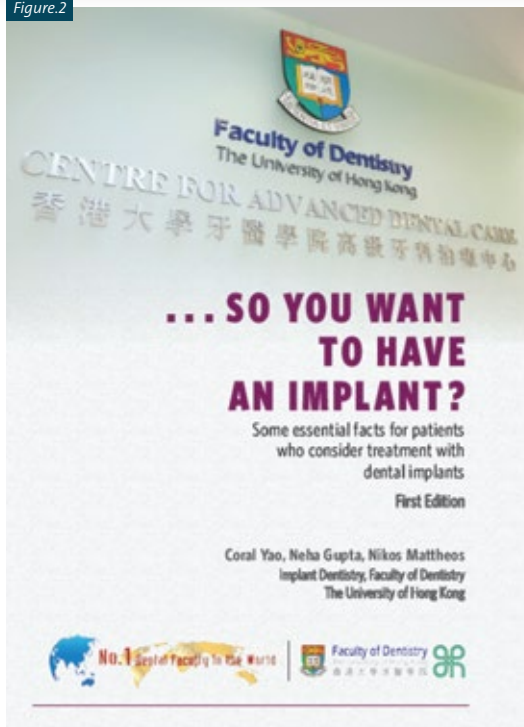


Figure.3



Figure.3a



Figure.3b

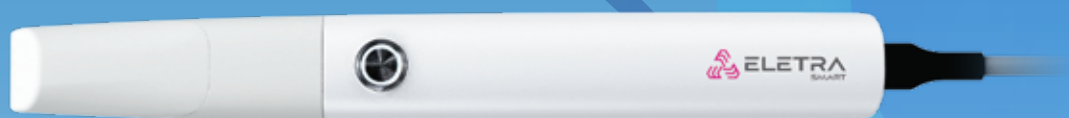


Figure.3c



References

- Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. *BMJ*. 1996 Jan 13;312(7023):71-2.
- Yao J, Tang H, Gao XL, McGrath C, Mattheos N. Patients' expectations to dental implant: a systematic review of the literature. *Health Qual Life Outcomes*. 2014 Oct 29;12:153.
- Sermisripoca K, Pisarnaturakit PP, Mattheos N, Pimkhaokham A, Subbalekha K. Comparing pre- and post-treatment patients' perceptions on dental implant therapy. *Clin Implant Dent Relat Res*. 2021 Oct;23(5):769-778.
- Yao J, Li M, Tang H, Wang PL, Zhao YX, McGrath C, Mattheos N. What do patients expect from treatment with Dental Implants? Perceptions, expectations and misconceptions: a multicenter study. *Clin Oral Implants Res*. 2017 Mar;28(3):261-271.
- Korfage A, Raghoobar GM, Meijer HJA, Vissink A. Patients' expectations of oral implants: a systematic review. *Eur J Oral Implantol*. 2018;11 Suppl 1:S65-S76.
- Abrahamsson KH, Wennström JL, Berglundh T, Abrahamsson I. Altered expectations on dental implant therapy; views of patients referred for treatment of peri-implantitis. *Clin Oral Implants Res*. 2017 Apr;28(4):437-442.
- Abu Hantash RO, Al-Omiri MK, Al-Wahadni AM. Psychological impact on implant patients' oral health-related quality of life. *Clin Oral Implants Res*. 2006 Apr;17(2):116-23.
- Al Shuhayb BS, Bukhamsin S, Albaqshi AA, Omer Mohamed F. The Prevalence and Clinical Features of Body Dysmorphic Disorder Among Dermatology Patients in the Eastern Province of Saudi Arabia. *Cureus*. 2023 Jul 26;15(7):e42474.
- Nabavizadeh SS, Naseri R, Sadeghi E, Afshari A, Dehdari Ebrahimi N, Sadeghi A. Prevalence of body dysmorphic disorder in rhinoplasty candidates: A systematic review and meta-analysis. *Health Sci Rep*. 2023 Aug 17;6(8):e1495.
- James M, Clarke P, Darcey R. Body dysmorphic disorder and facial aesthetic treatments in dental practice. *Br Dent J*. 2019 Nov;227(10):929-933.
- Bjornsson AS, Didie ER, Phillips KA. Body dysmorphic disorder. *Dialogues Clin Neurosci*. 2010;12(2):221-32.
- Romandini M, Lima C, Pedrinaci I, Araoz A, Costanza Soldini M, Sanz M. Clinical signs, symptoms, perceptions, and impact on quality of life in patients suffering from peri-implant diseases: a university-representative cross-sectional study. *Clin Oral Implants Res*. 2021 Jan;32(1):100-111.
- Esteve-Pardo G, De-Larriva E, Sanchez-Suarez LM, Sanchez-Nicolas JA, Bernabeu-Esclapez A, Esteve-Colomina L. How do implant patients experience complications? A cross-sectional multicentre pilot study. *Clin Oral Implants Res*. 2023 Sep;34(9):987-998.



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DOCTOR'S SHARING

BY DR. ALVIN YEO, DENTAL SURGEON, SINGAPORE

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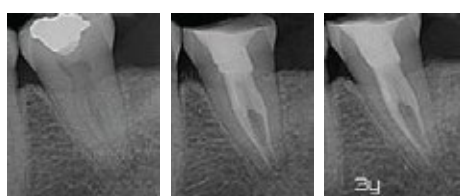


CeraSeal Clinical Case

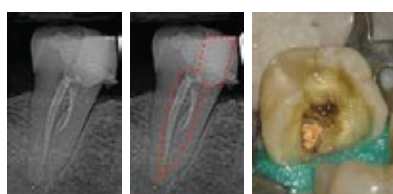
by Dr. Filippo Cardinali



Retreatment of 1.5 with apical lesion and sinus tract: **3y follow-up.** Cold Hydraulic Condensation obturation technique using a single cone and CeraSeal bioceramic sealer in both canals. After the delivery of the sealer in the middle and coronal thirds, cones were slowly inserted in the canals and then removed to assess the presence of the sealer at apical level; in this case I added CeraSeal at the tip of the cones to secure its presence in the apical third. The hydraulic pressure, generated during the insertion of the cones and during the packing at orifice level, and the flowability of the CeraSeal are responsible for the injection of the lateral canal that sustains the lateral lesion. The 3 years follow up shows the complete healing of the lesion. 📺



Treatment of 3.7 with Apical Periodontitis 3 years follow-up. This 37 has a C-Shape canal configuration; the 2 mesial are merging, the distal canal has an independent foramen. The narrow connection between canals is really challenging to clean, to properly fill during the obturation and very difficult to dry. In the video you can clearly see the communication between the buccal canals during the delivery of the sealer, the sealer in the narrow coronal communication and how the sealer appears in the distal canal moving the GP cone in the buccal canal, that means that there is a second communication area in the apical third. In these cases we do add sealer to completely fill the root canal space, the hydraulic pressure allow the filling of these narrow spaces, and the humidity present at that level won't interfere with the setting of the CeraSeal. At 3 years everything is running well, even though the patient refused to do a full cuspal coverage restoration. 📺



Retreatment of 4.7 with Apical Periodontitis - 4 years follow-up. Very low quality obturation in this 47 even because of a wrong access cavity design. Once corrected the access, it was easy to remove the old obturation material. This tooth has a C-Shape canal configuration with a mesial and distal canal merging at apical level. The canals were obturated using the Cold Hydraulic Condensation Technique with CeraSeal bioceramic sealer: the proper delivery of the sealer and the hydraulic pressure, generated during the insertion of the cones and during the packing at orifice level allowed the CeraSeal to completely fill the narrow space between the canals and to inject an accessory foramen. 4 years follow-up with complete remission of apical periodontitis symptoms. 📺



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Exploring the Complex Relationship Between the World's Beloved *Beverage & Health*

Introduction

Coffee, a beloved beverage cherished by millions across the globe, entices with its unique flavors and delivers a quick surge of energy. Yet, the impact of coffee on our health remains a subject of ongoing debate. In this enlightening article, we delve into the intricate relationship between coffee and our well-being, exploring its effects on various aspects of health.

Coffee and Cardiovascular Health

One of the extensively studied areas concerning coffee's impact on health is its relationship with cardiovascular wellness. Research shows moderate coffee consumption, typically defined as 3-5 cups per day, may reduce the risk of cardiovascular disease. Coffee contains compounds like chlorogenic acid and quinines, which have demonstrated the ability to enhance blood vessel function and reduce inflammation.

However, it is important to note that excessive coffee consumption, exceeding 6 cups per day, may elevate blood pressure and heart rate, potentially increasing the risk of cardiovascular disease. Therefore, consuming coffee in moderation is key.

Coffee and Type 2 Diabetes

Notably, regular coffee consumption has been associated with a decreased risk of developing type 2 diabetes. Studies suggest that coffee can improve insulin sensitivity and reduce inflammation, both crucial factors in preventing this metabolic disorder.

In fact, one study found that individuals who consumed 3-4 cups of coffee per day had a 25% lower risk of developing type 2 diabetes compared to those who consumed little to no coffee. However, it is important to be mindful that adding sugar and cream to coffee can diminish these potential benefits and potentially increase the risk of developing type 2 diabetes.

Coffee and Liver Health

The positive impact of coffee extends to liver health as well. Research indicates that coffee consumption may decrease the risk of liver cancer, cirrhosis, and non-alcoholic fatty liver disease.

One study revealed that individuals who consumed 3-4 cups of coffee per day had a remarkable 70% lower risk of developing liver cancer compared to those who consumed less than one cup per day. Additionally, another study highlighted that coffee intake could potentially reduce the risk of cirrhosis by up to 80%.

Coffee and Cognitive Function

Emerging research suggests that coffee consumption can enhance cognitive function. Caffeine, the primary active ingredient in coffee, has been shown to improve attention, alertness, and memory.



One study demonstrated that individuals who consumed 200mg of caffeine, roughly equivalent to one cup of coffee, exhibited improved cognitive function and heightened alertness compared to those who received a placebo.

However, it is important to exercise caution, as excessive coffee consumption can lead to anxiety and insomnia, potentially impairing cognitive function.

Coffee and Cancer Risk

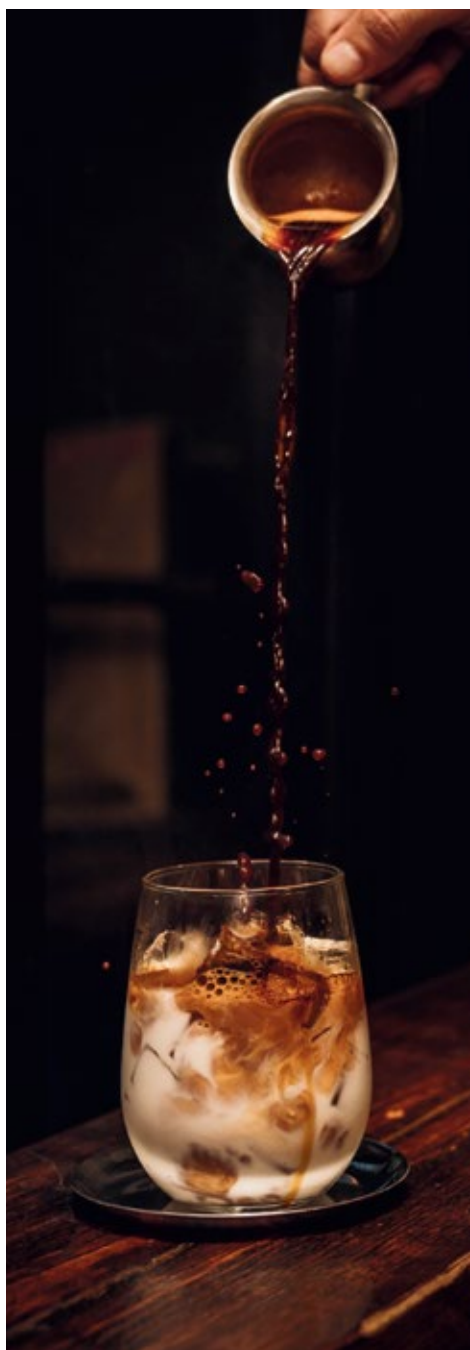
Remarkably, coffee consumption has also been associated with a reduced risk of certain types of cancer. Studies suggest that regular coffee intake may diminish the likelihood of developing liver cancer, colorectal cancer, and endometrial cancer.

For instance, one study revealed that individuals who consumed 2-3 cups of coffee per day had a remarkable 38% lower risk of developing liver cancer compared to those who consumed less than one cup per day. Additionally, another study found that coffee consumption may reduce the risk of colorectal cancer by up to 15%.

Coffee and Pregnancy

It is crucial to acknowledge that excessive coffee consumption during pregnancy can elevate the risk of miscarriage and contribute to low birth weight. As such, it is recommended that pregnant women restrict their coffee intake to less than 200 mg per day, which is roughly equivalent to one cup of coffee.

Furthermore, it is important to note that caffeine can pass through breast milk and potentially disrupt the sleep patterns of breast-fed infants. Therefore, breastfeeding women should also limit their coffee consumption.



Conclusion

Coffee consumption presents a complex interplay of potential benefits and drawbacks concerning our health. Moderate coffee intake has been associated with a reduced risk of cardiovascular disease, type 2 diabetes, liver ailments, cognitive decline, and certain cancers. However, excessive coffee consumption can heighten the risk of cardiovascular disease, impair sleep, and exacerbate anxiety levels. It is crucial to enjoy coffee in moderation while remaining mindful of any potential adverse effects. Additionally, it is important to acknowledge that the addition of sugar and cream to coffee can counteract its potential benefits, potentially increasing the risk of developing certain health conditions.



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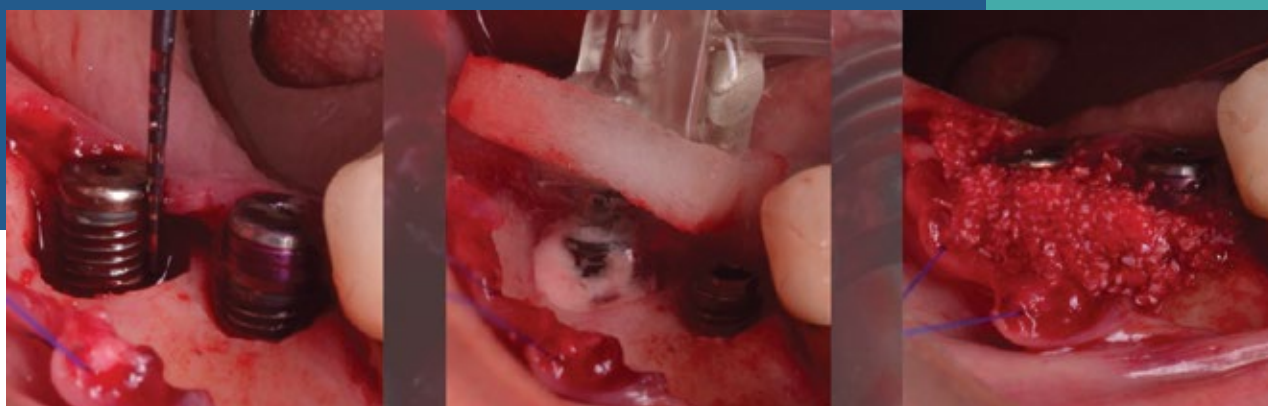
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Surgical Therapeutic Modalities of Peri-Implantitis



Alberto Monje Correa



Background

Peri-implantitis is regarded as a biofilm-mediated inflammatory condition that leads to progressive bone loss (Fig. 1). In addition, it is suggested that peri-implantitis leads to an increased systemic status of inflammation (Blanco et al. 2021; Chaushu et al. 2020). This may increase an individual's susceptibility to life-threatening conditions (Blanco et al. 2021). Therefore, peri-implant infections must be promptly diagnosed and eliminated.

The therapeutic target in managing this disorder is to shift from an anaerobic towards an aerobic ecosystem to arrest disease progression. Accordingly, the primary endpoint must be to close the peri-implant pocket ($\leq 5\text{mm}$). To achieve such a goal, nonsurgical measures have shown unsatisfactory outcomes regarding disease resolution (Hentenaar et al. 2020). Hence, surgical strategies are often demanded to achieve stability. This therapeutic option demonstrates enhanced predictability and effectiveness levels in the long-term stability of the peri-implant hard and soft tissues (Faggion et al. 2013).

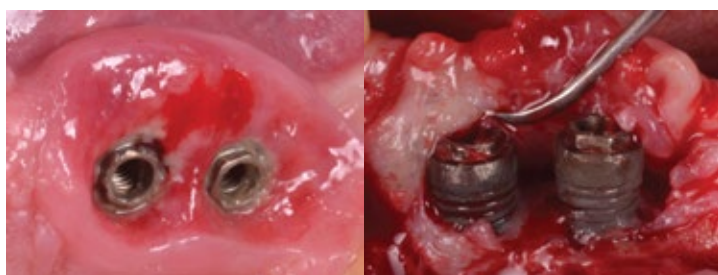


Fig.1: Peri-implantitis manifests with clinical signs of inflammation and bone loss

The surgical therapeutic modality relies upon multiple aspects that have to be meticulously examined. Generally, peri-implantitis-related contained bone defects are prone to favorable reconstructive/regenerative outcomes and a consistent reduction in the pocket depth (Schwarz et al. 2010; Aghazadeh et al. 2020). On the other hand, applying the principles of bone regeneration to non-contained defects is discouraged. Resective measures are advocated, including osseous recontouring and/or soft tissue resective surgery. This review aims to provide some tips and pearls for successfully managing peri-implantitis.

Technical principle behind the therapy of peri-implantitis

The goal in the surgical therapy of peri-implantitis from the technical perspective is to shift from a negative to a positive or flat bone architecture that assists in the resolution of inflammation. Hence, in supra-crestal lesions, the goal is to flatten the bone using osteoplasty/osteotomy, while in intra-bony lesions, a flat architecture is reached through bone reconstruction.

Peri-implantitis bone defect morphology

Bone defects are classified according to defect morphology and the and the number of supporting walls.

- Class I: Intrabony defect
 - Class Ia: Buccal dehiscence
 - Class Ib: 2/3-wall intrabony defect
 - Class Ic: Circumferential intrabony defect (4-wall defect)
- Class II: Supracrestal defect
- Class III: Combined defect
 - Class IIIa: Buccal dehiscence + supracrestal defect
 - Class IIIb: 2-3 walls intrabony defect + supracrestal defect
 - Class IIIc: Circumferential intrabony defect (4-wall defect) + supracrestal defect

Resective therapy

This therapeutic modality is applied to non-contained defects. Non-contained defect configurations might be attributable to the lack of adjacent bony peaks, implant position, or the pattern of bone loss in a bucco-lingual perspective. In other words, class Ia, II, and IIb are candidates for resective therapy (Fig. 2).



Fig.2: Resective therapy for non-contained defects entails osteoplasty and an apically positioned flap aimed at reducing pocket depth. Note disease resolution at 24-month follow-up

Flap design relies primarily on bone defect depth assessed using bone sounding and the width of keratinized mucosa (KM). It must be kept in mind that the goal is to reduce pocket depth; nevertheless, maintenance of ≥ 2 mm of keratinized mucosa on the buccal aspect is desirable. In scenarios with a narrow band of keratinized mucosa at the buccal aspect, a conservative approach in the buccal aspect is recommended as well as limiting excision to the palatal/lingual aspect. If no KM is present whatsoever, simultaneous soft tissue conditioning using a free epithelialized graft is indicated (Monje et al. 2020; Monje et al. 2021). For that, a full-thickness flap should be raised in the crestal area to access the uneven alveolar bone architecture and a partial thickness on the buccal flange to leave the periosteum attached to the bone. Osteoplasty and/or ostectomy must be performed with a diamond bur at the crestal aspect. Implantoplasty is recommended given that the implant surface will be deliberately exposed to the oral cavity, and any macro-geometrical (threads) and micro-structural (topographic roughed characteristics) features may lead to re-contamination of the pathogenic microbiome. The flap should be apically repositioned using an external vertical mattress suture.



Fig. 3: Contained defects can be managed by means of reconstructive therapy. Surface decontamination is key to success. In this case, mechanical decontamination (titanium brush) combined with an electrolytic approach (GalvoSurge, Straumann) were applied followed by regeneration by means of a mixture of autogenous bone and xenogeneic graft. The radiographic and clinical outcomes at the 12-month follow-up indicate disease resolution and radiographic bone gain

Reconstructive therapy

A full-thickness flap must be raised to achieve access. Subsequently, debridement can be performed with curettes or ultrasonic devices. Surface decontamination is key to success (Fig. 3). The therapeutic strategy relies vastly on implant position. If the implant is within the bony housing, reconstructive therapy is indicated after comprehensive surface detoxification (Monje et al. 2022). Given that these defects are contained or partially contained, a volume-stable bone grafting material or a barrier membrane may favor graft stability. On the other hand, if the implant is outside of the bony housing, implantoplasty is advised for the area where the reparative potential is incomplete (see the combined therapy). For the intrabony component within the bony housing, reconstructive therapy is indicated (Monje & Schwarz, 2021). Repositioning of the flap is recommended, given that mucosal recession will spontaneously occur in the aspect where implantoplasty was performed. That, together with bone reconstruction in the intrabony component, would mediate the resolution of inflammation by reducing pocket depth. If, at the re-assessment, there is no or limited band of keratinized mucosa, it might be advisable to augment it by means of a free epithelialized graft.

Combined therapy

A full-thickness flap must be elevated to access the defect. In the case of abundant KM, partial excision of the epithelium is recommended. Otherwise, an intra-sulcular incision must be performed with the goal of isolating the soft tissue lesion and leaving it attached to the implant and bone defect. The lesion must be removed using curettes. Implantoplasty is recommended for the supracrestal component, while surface decontamination strategies are to be applied in the intrabony compartment. If the implant is slightly outside the bony housing, implantoplasty would also be indicated for this aspect. This is the so-called combined therapy described initially elsewhere (Schwarz et al. 2011). Due to the nature of the defect, stabilizing bone fillers with a barrier membrane is encouraged. The flap must be apically positioned to reduce pocket depth. As a result, the polished surface will be exposed to the oral cavity. Again, if there is no or limited band of keratinized mucosa at the re-assessment, it might be advisable to augment it by means of a free epithelialized graft.

Conclusion

Surgical therapeutic strategies are proposed according to defect configuration to achieve clinical resolution of disease using flattening bone architecture. Further, it is critical to address local factors related to soft tissue characteristics and prosthesis design that contribute to disease initiation and may lead to recurrence. Adherence to a periodic supportive maintenance program is decisive for long-term stability.

References

Aghazadeh A, Persson RG, Renvert S. Impact of bone defect morphology on the outcome of reconstructive treatment of peri-implantitis. *Int J Implant Dent* 2020; 6:33.

Blanco C, Linares A, Dopico J, et al. Peri-implantitis, systemic inflammation, and dyslipidemia: a cross-sectional biochemical study. *J Periodontol Implant Sci* 2021; 51:342-351.

Chaushu L, Tal H, Sculean A, Fernandez-Tome B, Chaushu G. Peri-implant disease affects systemic complete blood count values-an experimental in vivo study. *Clin Oral Investig* 2020; 24:4531-4539.

Faggion CM, Jr., Chambrone L, Listl S, Tu YK. Network meta-analysis for evaluating interventions in implant dentistry: the case of peri-implantitis treatment. *Clin Implant Dent Relat Res* 2013; 15:576-588.

Hentenaar DFM, De Waal YCM, Van Winkelhoff AJ, Meijer HJA, Raghoobar GM. Non-surgical peri-implantitis treatment using a pocket irrigator device; clinical, microbiological, radiographical and patient-centred outcomes-A pilot study. *Int J Dent Hyg* 2020; 18:403-412.

Monje A, Amerio E, Cha JK, et al. Strategies for implant surface decontamination in peri-implantitis therapy. *Int J Oral Implantol (Berl)* 2022; 15:213-248.

Monje A, Blasi G, Nart J, Urban IA, Nevins M, Wang HL. Soft Tissue Conditioning for the Surgical Therapy of Peri-implantitis: A Prospective 12-Month Study. *Int J Periodontics Restorative Dent* 2020; 40:899-906.

Monje A, Pons R, Amerio E, Wang HL, Nart J. Resolution of peri-implantitis by means of implantoplasty as adjunct to surgical therapy: A retrospective study. *Journal of periodontology* 2021.

Monje A, Schwarz F. Principles of Combined Surgical Therapy for the Management of Peri-Implantitis. *Clin Adv Periodontics* 2021.

Schwarz F, Sahm N, Iglhaut G, Becker J. Impact of the method of surface debridement and decontamination on the clinical outcome following combined surgical therapy of peri-implantitis: a randomized controlled clinical study. *J Clin Periodontol* 2011; 38:276-284.

Schwarz F, Sahm N, Schwarz K, Becker J. Impact of defect configuration on the clinical outcome following surgical regenerative therapy of peri-implantitis. *J Clin Periodontol* 2010; 37:449-455.





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Dental Industry News

Researchers Develop 'Game-Changing' Implant Technology Using Ultraviolet Light

A team of researchers from UCLA School of Dentistry has developed a groundbreaking dental implant technology using ultraviolet (UV) light. After a decade of research, the team found that a layer of hydrocarbons naturally deposits on titanium pellicle implant surfaces, hindering osseointegration and leading to complications in many patients.

The recent technology involves blasting UV light treatment on titanium implants for one minute, effectively removing the hydrocarbons and reducing the risk of post-treatment complications. The technology offers faster healing times, near perfect osseointegration, and more versatile occlusion, resulting in reduced need for smaller implant crowns and bridge implants. Additionally, the UV treatment promotes the sealing of implants by gingival cells, limiting bacterial invasion and the occurrence of peri-implantitis. The researchers believe this technology can revolutionize implant dentistry and improve overall oral and general health.



Consumer Council Rates 11 Toothpaste Brands with 5 Stars - 90% Found to Contain Heavy Metals

Hong Kong's Consumer Council has conducted a toothpaste test, resulting in a rating of 11 brands with 5 stars. The test included 30 toothpaste brands, consisting of 17 regular toothpaste brands and 13 children's toothpaste brands. Out of the 30 tested, 11 regular toothpaste brands received a perfect 5-star rating, while 27 brands were found to contain trace amounts of heavy metals. It is important to note that some samples also contained allergenic fragrances that were not labeled. The test revealed that 90% of the samples contained heavy metals within the permissible limits set by mainland China's Cosmetic Safety Technical Specification.

The Transformative Influence of AI on Case Acceptance and Patient Trust

In the dynamic field of dentistry, the integration of artificial intelligence (AI) is revolutionizing the way dentists engage with their patients. Establishing trust and achieving case acceptance can sometimes be challenging, but with the advent of AI technology, dentists are discovering a powerful ally in fostering transparent and informed decision-making. This article delves into the symbiotic relationship between AI and dental case acceptance, shedding light on the transformative benefits it brings to both dental professionals and their patients.

Building Trust through Transparency

Transparency forms the bedrock of trust between dentists and patients. However, patients may occasionally exhibit skepticism, doubting diagnoses or questioning X-ray findings. By harnessing AI technology, dentists can enhance transparency and eliminate doubt. AI algorithms can analyze complex data sets and generate visually appealing and objective presentations, adding clarity to diagnoses and treatment plans. By presenting comprehensive and easily understandable information, dentists can empower patients to make informed decisions about their oral health.

Uncovering Hidden Pathologies

Traditional X-rays may not always reveal subtle or hidden pathologies. This is where AI excels. Studies have demonstrated the remarkable accuracy of AI applications in dental radiology. Computer vision AI systems have shown detection accuracy rates of up to 97.6% for identifying dental restorations and caries. By leveraging AI's capabilities, dentists can access an invaluable tool that assists with difficult diagnoses, provides on-the-spot "second opinions," and helps uncover pathologies that may have gone undetected otherwise.

Enhancing Patient Understanding

Effective communication plays a pivotal role in case acceptance. AI technology offers an educational advantage by simplifying complex diagnostic details and presenting them to patients in a more digestible format. AI-generated annotations on X-rays can augment patient comprehension, enabling them to grasp the intricacies of their diagnoses. This heightened understanding empowers patients to actively participate in treatment decisions, leading to increased engagement and a sense of ownership over their oral health.

Promoting Higher Standards of Care

AI acts as a supportive partner to dental professionals, complementing their expertise rather than replacing it. By leveraging AI's objectivity and accuracy, dentists can provide the highest standard of care to their patients. With AI's assistance, dentists can navigate challenging diagnoses, validate treatment plans, and ensure that patients receive the most appropriate care. By embracing AI as an indispensable tool, dental professionals can cultivate an environment of truthfulness and transparency, ultimately leading to improved patient outcomes and overall oral health.

The Surprising Link Between Oral Health and Dementia

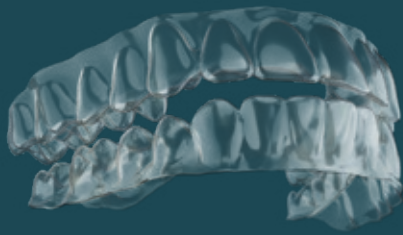
When it comes to maintaining good oral health, most people focus on brushing and flossing to prevent cavities and gum disease. However, recent research suggests that taking care of your teeth and gums may have implications beyond your oral hygiene. A growing body of evidence reveals a surprising connection between oral health and the risk of developing dementia. In this article, we explore the fascinating link between oral health practices and brain health, shedding light on the potential benefits of proper oral care in safeguarding against dementia.

The Oral-Brain Health Connection

Studies have found that poor oral health, such as gum disease and tooth loss, is associated with a higher risk of cognitive decline and dementia. The exact mechanisms behind this connection are still being investigated, but researchers believe that chronic inflammation caused by oral infections may play a pivotal role. Harmful bacteria from the mouth can enter the bloodstream and potentially reach the brain, triggering an inflammatory response that could contribute to the development of dementia.

Protective Measures for Brain Health

1. Maintaining good oral hygiene practices is crucial not only for a healthy smile but also for brain protection. Here are some key steps you can take to promote both oral and brain health:
2. Brush and floss regularly: Brushing your teeth at least twice a day and flossing daily helps remove plaque and prevent gum disease. By reducing oral bacteria, you may also reduce the risk of inflammation that could impact brain health.
3. Visit your dentist regularly: Regular dental check-ups and cleanings are essential for detecting and treating any oral health issues promptly. Your dentist can also provide personalized recommendations to optimize your oral hygiene routine.
4. Practice a healthy lifestyle: Adopting a well-rounded approach to health can benefit your brain as well. Engage in regular physical exercise, eat a balanced diet rich in fruits, vegetables, and whole grains, manage stress levels, and get enough quality sleep.
5. Stay hydrated: Drinking plenty of water helps maintain saliva production, which plays a crucial role in washing away bacteria and protecting your teeth and gums.
6. Avoid tobacco and excessive alcohol consumption: Smoking and heavy alcohol use have been linked to an increased risk of gum disease and cognitive decline. Quitting smoking and moderating alcohol intake can improve both oral and brain health.



Effect of trimming line design and edge extension of orthodontic aligners on force transmission: An in vitro study

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Abstract

Objectives: To investigate how the stress distribution and forces transmitted from orthodontic aligners to the tooth surface are affected by the geometry and extension of the trimming line.

Materials and methods: Thirty-six aligners were thermoformed from Zendura FLX sheets (0.75 mm thick) and divided into four groups based on the design of the trimming line: Scalloped, Scalloped extended, Straight and Straight extended. Fuji pressure-sensitive films were used for pressure measurement. The pressurized films were scanned and evaluated. Pressures and forces were measured over the entire facial surface of an upper right central incisor (Tooth 11) and at 7 different locations [cervical, middle, incisal, mesio-incisal, mesio-cervical, disto-incisal, and disto-cervical]. In addition, the thickness of the aligners at these 7 sites was measured with a digital caliper.

Results: The active force ranged from (2.2 to 6.9) N, and the average pressure was (1.6–2.7) MPa. The highest values were recorded for the (straight extended) design, while the lowest values were recorded for the scalloped design. The forces and stresses were not uniformly distributed over the surface. When the values in each area were compared separately, significant differences were found between the different designs in the cervical area, with the scalloped design transmitting the lowest cervical forces. Aligner thickness was drastically reduced (60–75% thinning) over the entire tooth surface after thermoforming.

Conclusions: The straight extended design of aligner's trimming line exhibited more uniform force transfer and stress distribution across the surface than the other designs.

Clinical Relevance: The trimming line design could have a significant impact on the clinical outcome of orthodontic aligner treatment.

Keywords: Biomechanics; Orthodontic force; Tooth movement; Removable thermoplastic appliance; Pressure sensitive Film; Stress analysis

1. Introduction

In the era of aesthetic dentistry, clear aligners are widely used due to their transparency, as well as their comfort and acceptance by patients, compared to fixed orthodontic braces ^[1]. Moreover, they are clinically and technically easier to be handled by dentists and patients. In addition, they need shorter chair-time and fewer dental appointments than fixed appliances ^[2,3]. Thanks to the simple oral hygiene measurements, patients with clear aligners can also maintain or even improve their periodontal health ^[4,5]. Orthodontic treatment with aligners is based on gradual movement of the teeth using a series of custom-made plastic splints, each of which can progressively move the targeted teeth by small amounts over a period of 10 to 14 days, approximately 0.2 mm for translations and 3 for rotations. Ideally, aligners should be worn the whole day, and removed only for eating, and teeth brushing ^[6,7].

In comparison with fixed braces, the force systems of aligners are more complex, as there are no specific, known points for force application and multiple parameters are used to determine the treatment outcome ^[8]. The biomechanical characteristics of aligners are influenced by aligner thickness ^[9,10], aligner extension ^[11], material properties ^[12,13], amount of activation ^[14,15], and attachments use ^[16]. Force transmission by aligners differs in that the geometry of the splint defines the amount and direction of tooth movement ^[17]. There is a pre-defined geometrical mismatch between the aligner splint and the crown of the treated tooth, which generates 3-dimensional force systems distributed over the entire contact area between the tooth and the aligner ^[18,19].

To achieve optimal outcomes of the aligner treatment, numerous studies have been conducted to evaluate the biomechanical characteristics of the aligners, either numerically using finite element methods ^[19–22], or experimentally using strain gauge sensors ^[23,24], pressure sensitive films ^[25,26], specialized sensors ^[15,27,28], along with different customized multi-axis force/torque biomechanical systems ^[6,29–31]. However, there is not yet a clear demonstration of the biomechanical system of aligners.

One of the factors that can influence the biomechanical behavior of the aligner is the design of the trimming line ^[11,32]. In this context, the aim of our current experiment is to study, using pressure-sensitive films, the distribution map of the contact pressure generated by the aligner on the tooth surface, and to understand how force levels, stress generation and stress distribution are affected by the geometry and extension of the trimming line of the aligner.

2. Materials and methods

2.1 Design of digital models and 3D printing

The upper right central incisor (Tooth 11) was selected as the treated tooth in the present study, because it has the flattest facial surface and is therefore suitable for the experiment. Additionally, most of the experimental reports refer to forces acting on the maxillary central incisor, so our results can be compared with those published in the literature.

At the beginning of the modeling, a digital model of an upper jaw was created from a three-dimensional data set of a maxilla with all 16 teeth (Digimation Corp., St Rose, Louisiana, USA). The digital model was imported as an STL file into an image processing and editing software (Mimics Innovation Suite, Mimics 24.0 / 3-matic 16.0; Materialise, Leuven, Belgium). In 3-matic software, three digital models were designed for different purposes in the study (Table 1). The first

model (1st Model) is an aligned model, with no tooth misalignments and with no housing space for the pressure-sensitive film. The second model (2nd Model) is also an aligned model, but with a housing space around the four anterior incisors and their corresponding gingival area (Fig. 1). This housing space was designed to eliminate the effects of the thickness of the pressure-sensitive film on the measurements and to make the results more realistic. The housing space was designed by digitally subtracting 100 μm from the targeted area using the solid uniform offset tool in 3- matic. In the third model (3rd Model), tooth 11 was bodily-translated 0.2 mm towards the facial direction, then a housing space was designed. The three digital models were exported as STL files to a 3D- printer (P20+; Straumann, Basel, Switzerland) and printed using a resin (P pro resin; Straumann, Basel, Switzerland).

Table 1. Table of different digital Models used in the current study, their description and the use of the corresponding 3D-printed models.

Model	Description	Purpose
1 st Model	An aligned model without any malposition of the teeth and without any housing space for the pressure film.	Thermoforming
2 nd Model	An aligned model with a created housing space around the four anterior incisors and the corresponding gingival area.	Measurement of the Passive Pressure
3 rd Model	The tooth 11 was translated 0.2 mm bodily to the facial direction, then a housing space was created.	Measurement of the Active Pressure

2.2 Thermoforming and trimming of the aligners

To investigate the effects of trimming line design, 36 aligners were thermoformed from thermoplastic sheets (Zendura FLX; Bay Materials LLC, Fremont, CA, USA) with a thickness of 0.75 mm. The 1st 3D-printed model, printed out of the 1st digital model, was used for thermoforming the aligner sheets. Thermoforming was carried out according to the manufacturer's guidelines (220 °C, 4.8 bar, 40 s) with a thermoforming device (Biostar; SCHEU-DENTAL GmbH, Iserlohn, Germany), which is functioning with positive pressure to allow better adaptation of the aligner to the 3D-printed model. The 36 aligners were divided into 4 groups, nine aligners per group (n=9), according to the design of the trimming line (Fig. 2): Scalloped trimming following the gingival line of each tooth (Scalloped); Scalloped trimming extended 2 mm beneath the gingival line (Scalloped Extended); Straight trimming at the level of the gingival line (Straight); and Straight trimming extended 2 mm beneath the gingival line (Straight Extended). Thermoforming and trimming of the aligners were done by a trained technician, in order to standardize the trimming line design of each group.

2.3 Method of measuring pressure with pressure sensitive films

2.3.1 Types of pressure sensitive films

Pressure sensitive films (Fuji Prescale Film; Fuji Film, Tokyo, Japan) were used for pressure measuring. These films are provided either in mono-sheet type or two-sheet-types. Both types are available in different sensitivity levels, each with a specific effective range. In the current study, we used the two-sheet type films, which are typically supplied in A-transfer sheet and C-developer sheet, whose combined thickness was specified by the manufacturer to be about 100 μm . The A-film contains microcapsules manufactured to rupture and react with an active layer of developing material on the C-film depending on the pressure applied, so that the optical density response corresponds to the pressure intensity and is expressed as a change in color intensity from pale pink to dark red [33].

In the present study, the super low pressure (LLW) film, whose sensitivity range is 0.5–2.5 MPa, was used for measuring the passive pressure resulting from the passive contact between the aligner and the 2nd printed model (aligned model). The low pressure (LW) film, whose sensitivity range is 2.5–10.0 MPa, was used for measuring the active pressure resulting from active contact between the aligner and the 3rd printed model (malaligned model).

2.3.2. Steps of pressure recording

In the test phase, parts of the two pressure foils were cut to fit into the housing space designed for them in the 2nd and the 3rd printed models (Figs. 3 and 4). They were then inserted carefully between the aligner and the printed model avoiding the application of any unwanted compressive or shear stress. For each individual aligner, both passive and active pressures were measured (Fig. 4). For each measurement, the pressure film was held at the designated location between the aligner and the printed model for 2 minutes in order to measure the continuous pressure, not just the momentary pressure (pressure film manufacturer's guidelines). All measurements were carried out by a single, well-trained operator on the same 3D-printed models.

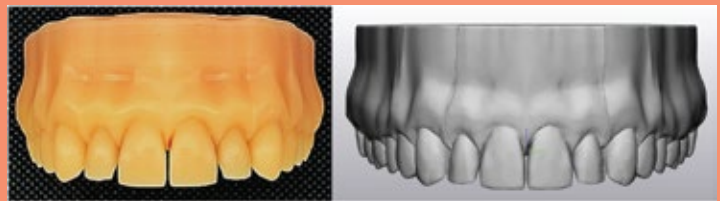


Fig. 1. Digital Model of an upper dental arch with a 100 μm deep space at the four anterior teeth region for housing of the pressure sensitive film (Right), corresponding 3D-printed model (Left).



Fig. 2. Different designs of trimming line of orthodontic aligners; from Left to Right: Scalloped, Scalloped Extended (2 mm), Straight, and Straight Extended (2 mm).



Fig. 3. Pressurized Fuji Prescale pressure sensitive film used for investigating the stress distribution map generated by clear aligner on the surface of a 0.2 mm facially malaligned upper right central incisor (Tooth 11) of a 3D-printed model.

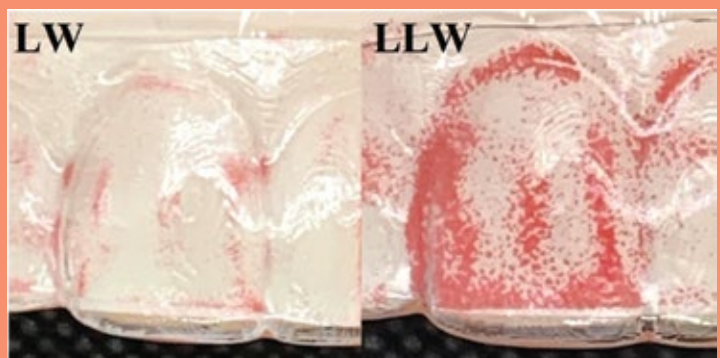


Fig. 4. Pressurized Fuji Prescale pressure sensitive film with different sensitivity used for investigating the stress distribution map generated by clear aligner; Low Pressure (LW) film for measuring the active pressure and Super Low Pressure (LLW) film for measuring the passive pressure.

2.3.3. Scanning of the pressurized films and extraction of data

The pressurized film of each measurement was scanned using a scanner (EPSON perfection V300 series; SEIKO Epson CORPORATION, Japan) which has a maximum resolution of 12,800 dpi. The scanning resolution was set at 0.125 (200 dpi). The pressure distribution recorded by each film has been analyzed, digitalized, and quantified using the software FPD-8010E analysis system (Fuji Film, Tokyo, Japan). With the help of the scan analysis software, the average pressure (MPa) and the force (N) over the entire facial surface of the tooth and at 7 different locations [Cervical (C), Middle (M), Incisal (I), Mesio-Incisal (MI), Mesio-Cervical (MC), Disto-Incisal (DI), and Disto-Cervical (DC)] of the facial surface of tooth 11 were defined and recorded (Fig. 5).

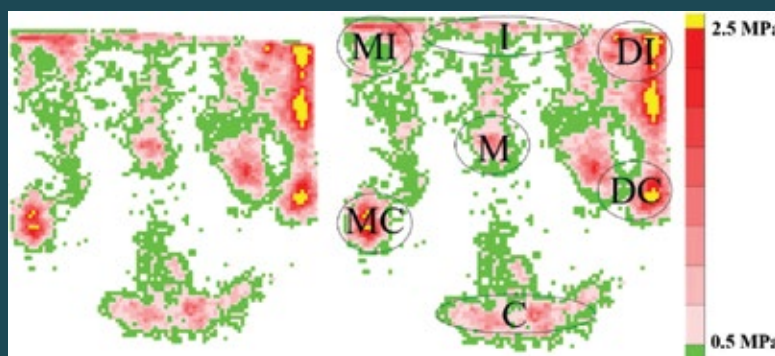


Fig. 5. A scan of a pressurized Fuji Prescale pressure sensitive film showing stress distribution map generated by a clear aligner over a 0.2 mm facially malaligned upper central incisor tooth (Tooth 11). Pressures and forces were measured by a special software at 7 different pre-defined areas; Cervical (C), Middle (M), Incisal (I), Mesio-Incisal (MI), Mesio-Cervical (MC), Disto-Incisal (DI), and Disto-Cervical (DC).

2.3.4. Calibration and standardization steps

Prior to scanning, the scanner was calibrated using a special calibration sheet supplied by the manufacturer. The type of scanned pressurized film was selected in the software, either LW or LLW. Additionally, the room temperature and the relative humidity were observed throughout the test procedure and measured with a digital meter (Technoline WS 9440 Indoor climate station; Technotrade GmbH, Wildau, Germany). The values of the temperature and the relative humidity were entered into the software to be included in the measurement and calculation process, since microcapsule rupture, subsequent reaction with the developing film, and final color density depend on both temperature and humidity. The temperature was measured in the range of 21 ± 2 °C, and the relative humidity was in the range of 29 ± 4 %. During scanning, the lustrous side of the pressurized A-Transfer sheet was fit into the scanner facing down, while the rough side (active color generation side) was facing up (manufacturer's instructions).

In order to exclude the factor of the lag time between the testing step and the scanning step of the pressurized film, a sensitivity analysis was performed by scanning the same pressurized films at 3 different times over a period of one hour (immediate scanning, after 30 minutes, and after an hour). With LLW and LW films, we found no difference in the recorded pressure values between the different scanning times, when all other factors were set fixed.

During aligner insertion, passive forces occur by default due to the good fit between the thermoformed aligner and the printed model, in addition to the undesirable forces generated during aligner insertion. Hence, care was taken at all times during the experiment to ensure that no unwanted pressure was applied to the films, especially during the insertion and removal of the pressure films. Also, the passive pressure generated by each aligner was subtracted from the active pressure generated by it, at each predetermined area, to get the real pressure (corrected values), generated due to the difference in the trimming line design. The active, the passive and the corrected values of the resulted pressures and forces were statistically analyzed.

2.4. Measurements of aligner thickness

Additionally, to study the variation of aligner thickness after thermoforming over the tooth, we have used a digital caliper (Dial Caliper D, AURA-DENTAL GmbH, Aura an der Saale, Germany) to measure the differential thickness at the center of the 7 previously mentioned areas (C, M, I, MI, MC, DI, and DC).

2.5. Statistical analysis

Numerical data were presented as mean and standard deviation (SD) values. They were explored for normality by checking the data distribution and using Shapiro-Wilk test. Data showed non-parametric distribution, so they were analyzed using Kruskal-Wallis test followed by Dunn's post hoc test with Bonferroni correction. The significance level was set at $p \leq 0.05$. Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows (R Foundation for Statistical Computing, Vienna, Austria).

3. Results

For each aligner individually and with a thorough evaluation of the forces and stress distribution over the surface, we found that the forces and stresses are not evenly distributed over the entire facial tooth surface. The stresses are concentrated mainly in 7 areas of the facial surface of the tooth 11; Cervical (C), Middle (M), Incisal (I), Mesio-Incisal (MI), Mesio-Cervical (MC), Disto-Incisal (DI), and Disto-Cervical (DC) (Fig. 5). There is a significant difference between each area of interest, the stresses and forces are highest at the incisal third of the tooth. The scan of the pressurized film was superimposed over the digital model to better visualize the stress distribution areas over tooth 11 (Fig. 6).

After scanning and measuring the stress values, significant differences are shown between the four different trimming designs (Figs. 6 and 7, Tables 2 and 3). The measured values of the mean active forces applied over the entire tooth surface were in the range of (2.2–6.9) N, the mean active pressure was in the range of (1.6–2.7) MPa, while the passive pressure was in the range of (0.3–1.3) MPa. The highest values of active force, active pressure, and passive pressure were recorded for the straight extended trimming design, and the lowest values were recorded for the scalloped design. On the other hand, there was no significant difference in corrected pressure values of the four different trimming designs (Fig. 7, Table 2). When comparing the different trimming designs, the difference in active force was significant at the cervical area including Cervical (C), Disto-Cervical (DC), and Mesio-Cervical (MC), with the scalloped design having the lowest values (Fig. 7, Table 3). The thickness of the aligner (0.75 mm) is drastically reduced to (0.2–0.3) mm (60–75% thinning) on the entire tooth surface after deep drawing, while it is less reduced (about 0.6 mm) (20% thinning) at the incisal edge, with no significant difference between different trimming line designs (Fig. 8).

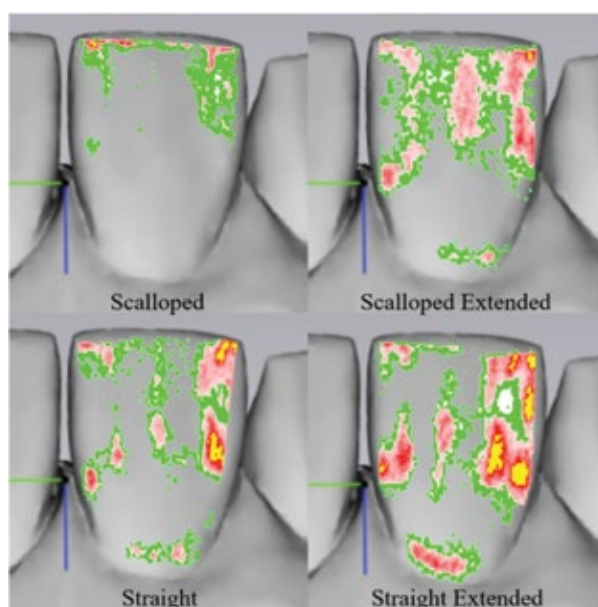


Fig. 6. A representative superimposition of the scan of a pressurized Fuji pressure sensitive film over the digital model for better understanding of the stress distribution areas over the upper right central incisor using different trimming line design; scalloped, scalloped extended, straight, straight extended.

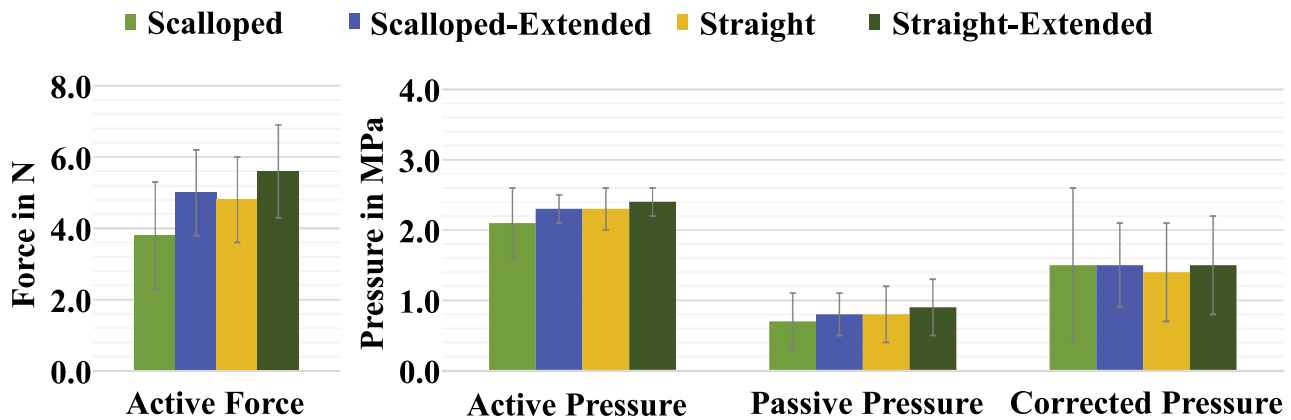


Fig. 7. Mean active force (in N), and mean active, passive, and corrected pressure (in MPa) exerted across the entire surface of tooth 11 by different trimming design of an orthodontic aligner.

Table 2. Mean active force (in N), and mean active, passive, and corrected pressure (in MPa) exerted across the entire surface of tooth 11 by different trimming design of an orthodontic aligner.

	Scalloped	Scalloped Extended	Straight	Straight Extended	p-value
Active Force (N)	3.8±1.5 ^B	5.0±1.2 ^{AB}	4.8±1.2 ^{AB}	5.6±1.3 ^A	0.010*
Active Pressure (MPa)	2.1±0.5 ^B	2.3±0.2 ^{AB}	2.3±0.3 ^{AB}	2.4±0.2 ^A	0.010*
Passive Pressure (MPa)	0.7±0.4 ^B	0.8±0.3 ^B	0.8±0.4 ^{AB}	0.9±0.4 ^A	0.001*
Corrected Pressure (MPa)	1.5±1.1 ^A	1.5±0.6 ^A	1.4±0.7 ^A	1.5±0.7 ^A	0.238

Different superscript letters indicate a statistically significant difference within the same horizontal row

*significant ($p < 0.05$).

Table 3. Active Forces (in N) generated from different trimming design of an orthodontic aligner at 7 different areas of the facial surface of tooth 11; Cervical (C), Middle (M), Incisal (I), Disto-incisal (DI), Disto-cervical (DC), Mesio-incisal (MI), and Mesio-cervical (MC).

Point	Force (active) (N) (Mean±SD)				p-value
	Scalloped	Scalloped Extended	Straight	Straight Extended	
C	0.2±0.4 ^B	2.1±1.2 ^A	0.8±0.7 ^B	2.0±1.1 ^A	<0.001*
M	0.1±0.3 ^B	1.2±1.0 ^B	1.1±1.1 ^B	3.2±1.5 ^A	<0.001*
I	5.3±3.2 ^A	4.4±1.6 ^A	3.6±1.7 ^A	4.6±2.0 ^A	0.423
DI	8.0±3.8 ^A	8.0±2.8 ^A	8.2±3.0 ^A	8.2±3.4 ^A	0.998
DC	4.2±2.9 ^C	8.2±3.0 ^{AB}	5.6±2.7 ^{BC}	9.4±2.2 ^A	<0.001*
MI	7.3±3.4 ^A	6.1±1.6 ^A	5.2±2.1 ^A	5.1±1.4 ^A	0.155
MC	1.0±0.5 ^B	5.0±2.6 ^A	4.8±1.9 ^A	6.7±2.1 ^A	<0.001*

Different superscript letters indicate a statistically significant difference within the same horizontal row

*significant ($p < 0.05$).

The thickness of the aligner (0.75 mm) is drastically reduced to (0.2–0.3) mm (60–75% thinning) on the entire tooth surface after deep drawing, while it is less reduced (about 0.6 mm) (20% thinning) at the incisal edge, with no significant difference between different trimming line designs (Fig. 8).

4. Discussion

Research into aligner design and material properties provides necessary information to address some of the drawbacks and limitations of aligners. Therefore, in this article, we have attempted to understand the effect of aligner trimming design and edge extension on force transmission and stress distribution using pressure-sensitive films. To our knowledge, these pressure-sensitive films have been used for the investigation of orthodontic aligners in only two studies: an in-vivo study by Barbagallo et al. [26] and another in-vitro study by Cervinara et al. [25]. Our research group sought to apply this technique to further investigate the biomechanics of aligners.

Biomechanical tooth movement is dependent on several factors. One is the resulting force, which in turn depends on its point of application, magnitude, and direction, and the other is the center of resistance of the tooth [34]. For example, to achieve a bodily tooth movement in a specific direction, the force vector should pass through the center of resistance of the targeted tooth. This is not directly achievable clinically because the center of resistance of the bone-anchored tooth is located somewhere in the root [35]. In the fixed braces system, it is possible to indirectly create a bodily tooth movement using some biomechanical approaches, involving for instance the use of wires with square section designed to apply a force couple opposite to the moment of the force around the center of resistance [34]. In contrast, in the aligner system, it is much more difficult to apply the same biomechanical techniques because the forces vary from the incisal to the gingival region and the mode of action of the aligner is based on a geometrical mismatch between tooth and aligner, and hence stresses are transferred to a wider and less defined contact area [18], [19], [20]. Therefore, the predictability of bodily movement in clear aligner treatment is generally limited, as recently noted in a comprehensive systematic review [36].

Although orthodontic aligners move teeth by pushing rather than pulling - which should allow intimate contact between the aligner and tooth surface facilitating even stress distribution and better force transmission [18] -, the uneven topography of the tooth surface plays a major role in the stress distribution resulting in uneven distribution of stress over the tooth surface. In agreement with Barone et al. [19] and Cervinara et al. [25], our study showed that the contact of the aligner with the tooth surface is not homogenous, there are areas of relief and others with intimate contact, and hence the force level differs from point to point all over the surface. The stress concentration areas recorded in the present experiment are similar somehow to those reported by Cervinara et al. [25]. In the current study, we have initiated a facial bodily translation of tooth 11. In order to create a bodily translation (the crown and the root apex move the same distance in the same horizontal direction), the aligner must conduct forces both at the incisal edge and at the gingival crevice, where the force at the gingival margin must exceed the force at the incisal edge due to the location of the force with respect to the center of resistance, otherwise a tipping movement will occur [34,37,38]. As shown in the results, none of the aligners tested could achieve that, but at least with the

(straight extended) design, the difference between the forces transmitted to the cervical area was significantly higher, and so the difference between the incisal forces and the cervical forces is smaller, and the tooth then has more probability to move bodily than in tipping pattern.

Trimming of the aligner in a scalloped form is mainly done to improve the aesthetic appearance of the aligner by following the natural gingival margins. However, this involves an unavoidable polishing step, which might lead to weakening of the material and excessive flexibility of the margins. As a result, the aligner gripping of the tooth is poorer and the force cervically is reduced^[38]. However, in the case of straight trimming, the polishing step could be considerably minimized. Additionally, with the extension of the margins, the grip and the control become better^[11,32].

The initial forces and stresses measured in this study are within the range of values reported in the literature. Cervinara et al.^[25] reported that the maximum passive pressure recorded was 1.5 ± 0.5 MPa, which is well-matched with our results (max. 1.3 MPa). The mean active pressure of 2.65 MPa calculated by Cervinara was also consistent with our results. Active force measurements were as well in the range of (2.2–6.9) N, which is corresponding to reports by Elkholy et al. (2.3–10.2 N)^[12,39] and Hahn et al. (3.9–5.4 N)^[10,40], who used customized biomechanical measuring systems on upper central incisors. Likewise, Xiaowei et al.^[15] reported force levels at (7.7 N) using a micro-stress sensor system. Similarly, Xiang et al.^[28] reported force values around 8.0 N using a thin-film pressure sensor. The slight difference between the values can be attributed to the variation in the experimental set-up and the used aligner material.

Nevertheless, for a bodily movement of upper central incisor, the recorded forces are higher than the ideal orthodontic forces (0.7–1.3 N)^[41,42]. Higher forces are expected and accepted in in-vitro studies because neither PDL nor bone are present in the experimental setups. Moreover, only the horizontal force components are involved in the tooth facio-lingual bodily movement, however, using the pressure sheet, we could measure the normal forces applied on the surface which include also the vertical component of the force added to the total force values. Additionally, the initial high force levels generated by aligners drop within the first 24 h of use, due to wear and fatigue^[23].

A well-fit well-retained aligner is expected to transmit higher forces and achieve a more accurate tooth movement^[11]. The passive forces, generated from the inherent contact between the passive aligner and the 3D-printed model, could be an indicator of the engagement and the retention of the aligner. In agreement with Cowley et al.^[11,37], the straight extended design showed the highest passive force, followed by the straight design, while the scalloped designs transmit the lowest forces. Also, Gao et al.^[32] reported that the forces generated by the aligner vary depending on the width of the aligner the trimming design and extension, with non-extended aligners generating significantly lower forces than those with extension.

Although the thickness of the aligner plays an important biomechanical role^[32], the irregular thickness of an aligner and the material thinning during deep drawing make it difficult to predict the treatment outcomes^[43]. It has been reported that the thickness variation of a thermoplastic material alters the force-deformation properties, with a reduction in thickness decreasing the stiffness and diminishing the transmitted force^[10,32]. Also, decreasing the thickness will increase local and bodily aligner deformation, and hence decrease tooth to aligner contact areas^[37]. In agreement with Jones et al.^[44] and Lee et al.^[43], we noted that the thermoforming process drapes over the model leading to a drastic thinning of the material (60–75%), especially in the middle and gingival regions, and less thinning at the incisal edge (around 20%). This reduction in thickness results in increased flexibility allowing for easier deformation, and increased risk of fracture. Therefore, in order to obtain a desired and predictable outcome, aligner thickness and material properties should be adjusted over the course of treatment^[37]. The use of 3D-printed aligners is proposed as an attempt to obtain a homogeneous thickness over the entire surface.

The limitations of the current study might be due to some factors, such as the exclusive choice of buccal translation as a test movement and the choice of a simulated single-tooth discrepancy (with a simplified force system as a result). Also, pressure sensitive films were developed for direct measurement of the pressure between two surfaces, and as a trial to overcome the bulky thickness of other pressure sensors. Although this technique is rapid, straight forward, and completely dry, it is very sensitive. It is also dependent on temperature, humidity, and load-rate. As well, Fuji suggests that stain density changes with time, therefore all stains should be recorded at a fixed time after application of pressure^[45].^[46],^[47]. Furthermore, in our in-vitro study, in spite of designing a housing space to exclude the pressure generated by the thickness of the pressure films (100 μ m), unavoidable additional pressure was to be expected, especially during insertion and extraction of the aligner, particularly in undercuts. In addition, the periodontal ligament and bone were not taken into account, so higher forces were to be expected. In addition, there are normal variations and geometric inaccuracies that occur during the thermoforming process^[32,43], therefore, we tried to control the process and standardize every step, and use a larger sample size (nine aligners per group). Finally, the experimental conditions did not allow for a realistic simulation of the intraoral environment in terms of temperature and humidity, which have significant effect on the mechanical properties of the aligner materials. Colder and drier conditions contribute to the generation of higher forces than in the intraoral environment.

Zendura FLX, which was used in the current study, is a multi-hybrid material developed to overcome the limitations of a single-layer material and to improve the physical properties of maximum tensile load-bearing capacity^[43]. Further studies will test other materials using the same technique to investigate the factor of material type. Also, the finite element method will be a useful tool to better understand the effects of the trim line design. In addition, the effect of aligner margin expansion on periodontal and gingival health should be investigated.

THICKNESS OF THE ALIGNER AT FACIAL PART OF TOOTH 11

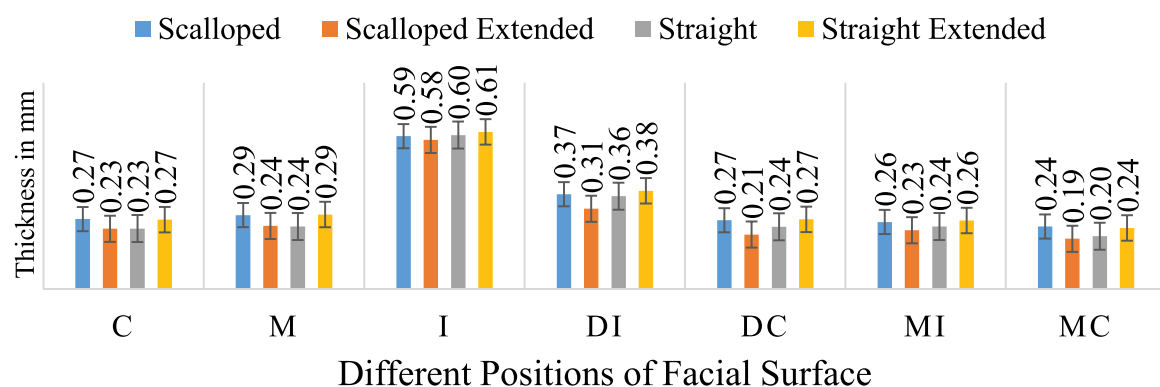


Fig. 8. Varying thickness (in mm) of different trimming designs of aligners after thermoforming at 7 different areas at the facial surface of tooth 11; Cervical (C), Middle (M), Incisal (I), Disto-Incisal (DI), Disto-Cervical (DC), Mesio-Incisal (MI), and Mesio-Cervical (MC).

5. Conclusions

- 1 During bodily movement of the upper central incisor by an orthodontic aligner, the stress is not evenly distributed over the tooth surface but concentrates at specific areas which could be considered as the force application areas.
- 2 Scalloped trimming leads to higher flexibility and material weakening at the marginal areas, which results in reduction of the amount of force applied on the tooth near the gingival area, decreasing the probability of accomplishing more complex movements (such as bodily translation).
- 3 Trimming of the aligner in (straight extended) design is a way to increase stiffness, retention, and gingival adaptation of the aligner, and consequently to achieve better stress distribution and better control of tooth movement, and apply more force at the gingival area, closer to the center of resistance, thus potentially improve control of bodily movement.
- 4 Thermoforming of aligner sheets is accompanied by a great reduction of the thickness (about 60–75% thinning), especially at the gingival and the middle area, which affects the generated force levels and the stress distribution.

Compliance with Ethics Requirements

This article does not contain any studies with human or animal subjects.

Ethical Approval

Not Applicable.

Informed Consent

Not Applicable.

Funding

This work was supported financially by Straumann AG company, Basel, Switzerland.

Conflicts of interest

The authors declare that they have no conflict of interest.

References

- [1] V.F. Didier, R.R. Almeida-Pedrin, P.V.P. Oltramari, T.M.F. Fernandes, L.L. Dos Santos, A.C. de C.F. Conti, Influence of orthodontic appliance design on employment hiring preferences, *Am. J. Orthod. Dentofac. Orthop.* 156 (2019) 758–766, <https://doi.org/10.1016/j.ajodo.2018.12.020>.
- [2] I. Tamer, E. Oztas, G. Marsan, Orthodontic treatment with clear aligners and the scientific reality behind their marketing: a literature review, *Turkish J. Orthod.* 32 (2019) 241–246, <https://doi.org/10.5152/TurkOrthod.2019.18083>.
- [3] F. Mehta, S. Mehta, Aligners: the rapidly growing trend in orthodontics around the world, *Indian J. Basic Appl. Med. Res.* 3 (2014) 402–409.
- [4] I. Sifakakis, W. Papaioannou, A. Papadimitriou, D. Kloukos, S.N. Papageorgiou, T. Eliades, Salivary levels of cariogenic bacterial species during orthodontic treatment with thermoplastic aligners or fixed appliances: a prospective cohort study, *Prog. Orthod.* 19 (2018) 1–9, <https://doi.org/10.1186/s40510-018-0230-4>.
- [5] G.M. Abbate, Periodontal health in teenagers treated with removable aligners and fixed orthodontic appliances, *J. Orofac. Orthop.* 76 (2015) 240–250, <https://doi.org/10.1007/s00056-015-0285-5>.
- [6] T.M. Elshazly, Potential application of 4D technology in fabrication of orthodontic aligners, *Front. Mater.* 8 (2022) 586, <https://doi.org/10.3389/fmats.2021.794536>.
- [7] T.M. Elshazly, Primary evaluation of shape recovery of orthodontic aligners fabricated from shape memory polymer (A Typodont Study), *Dent. J.* 9 (2021) 31, <https://doi.org/10.3390/dj9030031>.
- [8] S. Barone, A. Paoli, A.V. Rationale, R. Savignano, Design of customised orthodontic devices by digital imaging and CAD/FEM modelling, *Bioimaging* 3 (2016) 44–52.
- [9] D.-S. Liu, Y.-T. Chen, Effect of thermoplastic appliance thickness on initial stress distribution in periodontal ligament, *Adv. Mech. Eng.* 7 (2015), <https://doi.org/10.1177/1687814015578362>.
- [10] W. Hahn, Influence of thermoplastic appliance thickness on the magnitude of force delivered to a maxillary central incisor during tipping, *Am. J. Orthod. Dentofac. Orthop.* 136 (2009) 12.e1–12.e7, <https://doi.org/10.1016/j.ajodo.2008.12.015>.
- [11] D.P. Cowley, J. Mah, B. O'Toole, The effect of gingival-margin design on the retention of thermoformed aligners, *J. Clin. Orthod.* JCO 46 (2012) 697.
- [12] F. Elkholy, F. Schmidt, R. Jager, B.G. Lapatki, Forces and moments delivered by novel, thinner PET-G aligners during labio-palatal bodily movement of a maxillary central incisor: an in vitro study, *Angle Orthod.* 86 (2016) 883–890, <https://doi.org/10.2319/011316-37R.1>.
- [13] C.-T. Ho, Y.-T. Huang, C.-W. Chao, T.-H. Huang, C.-T. Kao, Effects of different aligner materials and attachments on orthodontic behavior, *J. Dent. Sci.* 16 (2021) 1001–1009, <https://doi.org/10.1016/j.jds.2021.01.011>.
- [14] S. Min, C.-J. Hwang, H.-S. Yu, S.-B. Lee, J.-Y. Cha, The effect of thickness and deflection of orthodontic thermoplastic materials on its mechanical properties, *Korean J. Orthod.* 40 (2010) 16–26, <https://doi.org/10.4041/kjod.2010.40.1.16>.
- [15] X. Li, C. Ren, Z. Wang, P. Zhao, H. Wang, Y. Bai, Changes in force associated with the amount of aligner activation and lingual bodily movement of the maxillary central incisor, *Korean J. Orthod.* 46 (2016) 65–72, <https://doi.org/10.4041/kjod.2016.46.2.65>.
- [16] F. Elkholy, B. Mikhael, S. Repky, F. Schmidt, B.G. Lapatki, Effect of different attachment geometries on the mechanical load exerted by PET-G aligners during derotation of mandibular canines, *J. Orofac. Orthop.* 80 (2019) 315–326, <https://doi.org/10.1007/s00056-019-00193-7>.
- [17] R.L. Boyd, V. Waskalick, Three-dimensional diagnosis and orthodontic treatment of complex malocclusions with the invisalign appliance, *Sem. Orthod.* 7 (2001) 274–293, <https://doi.org/10.1053/sodo.2001.25414>.
- [18] M. Upadhyay, S.A. Arqub, Biomechanics of clear aligners: hidden truths & first principles, *J. World Fed. Orthod.* 11 (2021) 12–21, <https://doi.org/10.1016/j.ejwf.2021.11.002>.
- [19] S. Barone, A. Paoli, A.V. Rationale, R. Savignano, Computational design and engineering of polymeric orthodontic aligners, *Int. J. Numer. Method. Biomed. Eng.* 33 (2017) e2839, <https://doi.org/10.1002/cnm.2839>.
- [20] S. Barone, A. Paoli, A.V. Rationale, R. Savignano, Computer aided modelling to simulate the biomechanical behaviour of customised orthodontic removable appliances, *Int. J. Interact. Des. Manuf.* 10 (2016) 387–400, <https://doi.org/10.1007/s12008-014-0246-z>.
- [21] Y. Cai, X. Yang, B. He, J. Yao, Finite element method analysis of the periodontal ligament in mandibular canine movement with transparent tooth correction treatment, *BMC Oral Health* 15 (2015) 106, <https://doi.org/10.1186/s12903-015-0091-x>.
- [22] J.P. Gomez, F.M. Penav, A. Martinez, D.C. Giraldo, C.I. Cardona, Initial force systems during bodily tooth movement with plastic aligners and composite attachments: a three-dimensional finite element analysis, *Angle Orthod.* 85 (2015) 454–460, <https://doi.org/10.2319/050714-330.1>.
- [23] A.D. Vardimon, D. Robbins, T. Brosh, In-vivo von Mises strains during Invisalign treatment, *Am. J. Orthod. Dentofac. Orthop.* 138 (2010) 399–409, <https://doi.org/10.1016/j.ajodo.2008.11.027>.
- [24] Y. Shi, C. Ren, W. Hao, M. Zhang, Y. Bai, Z. Wang, An ultra-thin piezoresistive stress sensor for measurement of tooth orthodontic force in invisible aligners, *IEEE Sens. J.* 12 (2012) 1090–1097, <https://doi.org/10.1109/JSEN.2011.2166065>.
- [25] F. Cervinara, Experimental study of the pressures and points of application of the forces exerted between aligner and tooth, *Nanomaterials* 9 (2019) 1010, <https://doi.org/10.3390/nano9071010>.
- [26] L.J. Barbagallo, G. Shen, A.S. Jones, M.V. Swain, P. Petocz, M.A. Darendeliler, A novel pressure film approach for determining the force imparted by clear removable thermoplastic appliances, *Ann. Biomed. Eng.* 36 (2008) 335–341, <https://doi.org/10.1007/s10439-007-9424-5>.
- [27] H. Son, K. Lee, J. Sim, H. Kim, J. Kim, W. Kim, Pressure differences from clear aligner movements assessed by pressure sensors, *Biomed. Res. Int.* (2020), <https://doi.org/10.1155/2020/8376395>. Article ID 8376395.
- [28] B. Xiang, The force effects of two types of polyethylene terephthalate glycol-modified clear aligners immersed in artificial saliva, *Sci. Rep.* 11 (2021) 1–10, <https://doi.org/10.1038/s41598-021-89425-8>.
- [29] M. Simon, L. Keilig, J. Schwarze, B.A. Jung, C. Bourauel, Forces and moments generated by removable thermoplastic aligners: incisor torque, premolar derotation, and molar distalization, *Am. J. Orthod. Dentofac. Orthop.* 145 (2014) 728–736, <https://doi.org/10.1016/j.ajodo.2014.03.015>.
- [30] F. Elkholy, F. Schmidt, R. Jager, B.G. Lapatki, Forces and moments applied during derotation of a maxillary central incisor with thinner aligners: an in-vitro study, *Am. J. Orthod. Dentofac. Orthop.* 151 (2017) 407–415, <https://doi.org/10.1016/j.ajodo.2016.08.020>.
- [31] W. Hahn, Initial forces and moments delivered by removable thermoplastic appliances during rotation of an upper central incisor, *Angle Orthod.* 80 (2010) 239–246, <https://doi.org/10.2319/033009-181.1>.
- [32] L. Gao, A. Wichelhaus, Forces and moments delivered by the PET-G aligner to a maxillary central incisor for palatal tipping and intrusion, *Angle Orthod.* 87 (2017) 534–541, <https://doi.org/10.2319/090216-666.1>.
- [33] <https://www.fujifilm.com/de/en/business/inspection/measurement-film/pre-scale>.
- [34] R.S. Nanda, Y.S. Tosun, Biomechanics in Orthodontics: Principles and Practice, Hanover Park Quintessence Publ, 2010, pp. 38–39.
- [35] S. Reimann, L. Keilig, A. Jager, C. Bourauel, Biomechanical finite-element investigation of the position of the centre of resistance of the upper incisors, *Eur. J. Orthod.* 29 (2007) 219–224, <https://doi.org/10.1093/ejo/cj086>.
- [36] Y.A. Yassir, S.A. Nabbat, G.T. McIntyre, D.R. Bearn, Clinical effectiveness of clear aligner treatment compared to fixed appliance treatment: an overview of systematic reviews, *Clin. Oral Investig.* 26 (2022) 2353–2370, <https://doi.org/10.1007/s00784-021-04361-1>.
- [37] D. P. Cowley, Effect of gingival margin design on retention of thermoformed orthodontic aligners, (2012), <https://doi.org/10.34917/4332643>.
- [38] O.C. Tuncay, The Invisalign System, Quintessence Publishing Company, 2006.
- [39] F. Elkholy, T. Panchaphongsaphak, F. Kilic, F. Schmidt, B.G. Lapatki, Forces and moments delivered by PET-G aligners to an upper central incisor for labial and palatal translation, *J. Orofac. Orthop.* 76 (2015) 460–475, <https://doi.org/10.1007/s00056-015-0307-3>.
- [40] W. Hahn, Initial forces generated by three types of thermoplastic appliances on an upper central incisor during tipping, *Eur. J. Orthod.* 31 (2009) 625–631, <https://doi.org/10.1093/ejo/cjp047>.
- [41] W.R. Proffit, H.W. Fields, D.M. Sarver, J.L. Ackerman, Contemporary Orthodontics, Mosby, Inc, St. Louis, 2000.
- [42] J.-S. Kwon, Y.-K. Lee, B.-S. Lim, Y.-K. Lim, Force delivery properties of thermoplastic orthodontic materials, *Am. J. Orthod. Dentofac. Orthop.* 133 (2008) 228–234, <https://doi.org/10.1016/j.ajodo.2006.03.034>.
- [43] S.Y. Lee, Thermo-mechanical properties of 3D printed photocurable shape memory resin for clear aligners, *Sci. Rep.* 12 (2022) 6246, <https://doi.org/10.1038/s41598-022-09831-4>.
- [44] M.L. Jones, J. Mah, B.J. O'Toole, Retention of thermoformed aligners with attachments of various shapes and positions, *J. Clin. Orthod.* 43 (2009) 113–117. PMID: 19276582.
- [45] A.B. Liggins, J.B. Finlay, E.G. Little, Recording contact areas and pressures in joint interfaces, *Exp. Mech. Technol. Transf. High Tech. Eng. Biomech.* (1992) 71–88.
- [46] A.B. Liggins, J.B. Finlay, Image-averaging in the analysis of data from pressure-sensitive film, *Exp. Tech.* 21 (1997) 19–22, <https://doi.org/10.1111/j.1747-1567.1997.tb00518.x>.
- [47] A.B. Liggins, J.C.E. Stranart, J.B. Finlay, C.H. Rorabeck, E.G. Little, Calibration and manipulation of data from Fuji pressure-sensitive film, *Exp. Mech. Technol. Transf. High Tech. Eng. Biomech.* (1992) 61–70.

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Design & Renovation	Cost of Design & Renovation	\$ 700,000	10%	\$ 630,000	\$ 70,000
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