

The diagnosis and treatment of malocclusion **Best practice statement**

Arising from a summit of key opinion leaders
Amsterdam January 10, 2020

WORKING GROUP

Corinne Attia, France

Christian Bitar, France

Elaine Halley, UK

Jan Kurtz-Hoffman, Germany

Nimmi Holstein (Chair), Denmark

Giuseppe Marano, Italy

Edouard Negre, France

Gianluca Plotino, Italy

Mark Sebastian, Germany

Darren Stone, UK

Andrew Toy, UK

Hannu Vesanen, Finland

The diagnosis and treatment of malocclusion
Best Practice Statement

Published by Page & Page
76 Calverley Road
Tunbridge Wells
TN1 2UJ

This document has been developed by Page & Page
and is supported by Align Technology.

This publication was coordinated by Page & Page with the Working Group.
The views presented in this document are the work of the participants and
do not necessarily reflect the views of Align Technology.

How to cite this document:

Page & Page: The diagnosis and treatment of malocclusion
Best Practice Statement. London: Page & Page, 2020.



align

FOREWORD

Dentists are ‘doctors who specialise in oral health’ but how should oral health be defined? The dentist’s remit embraces the inter-relationship between conditions of the mouth, the head, the jaws and the neck with overall health as well as, more routinely, the teeth, tongue, gums and mucosa.

In addition to diagnosing and treating disease, dentists have a responsibility for prevention, namely the promotion of oral health. This involves making patients aware of how their lifestyle impacts on the healthy functioning of their teeth and jaws.

From diet to stress and smoking cessation to oral hygiene, dentists and their teams should educate patients on keeping their mouth and jaws healthy. They should monitor the health and function of the occlusion, as well as the teeth and the supporting tissues for the promotion of health and wellness. Oral health is all-encompassing.

This is reinforced by the Federation Dentaire Internationale or the World Dental Federation, which describes oral health as: “... multi-faceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex.”¹

Oral health is a key indicator of overall health, wellbeing and quality of life, according to the World Health Organization (WHO)², which includes dental caries, periodontal disease, tooth loss, oral cancer, oral manifestations of HIV infection, oro-dental trauma, noma and birth defects, such as cleft lip and palate, as areas of concern.

The Global Burden of Disease Study 2017 estimated that oral diseases affect 3.5 billion people worldwide, with untreated caries being among the most prevalent non-communicable diseases.²

While not everyone with a malocclusion requires treatment, the FDI policy statement recognises the potential impact of a malocclusion on the healthy functioning of an individual’s mouth: “Malocclusion is a common health problem that may affect oral health by increasing dental caries prevalence, periodontitis, increasing risk for trauma, and difficulties in masticating, swallowing breathing, speaking and eating.”³

The FDI policy statement is groundbreaking due to the emphasis it places on the malocclusion.

“By considering malocclusion not only as an aesthetic problem, orthodontic treatment can prevent and intercept other oral diseases and improve the quality of life.”³

INTRODUCTION

In January 2020, a group of 12 clinicians and researchers from five European countries – Denmark, Finland, France, Germany, Italy and the UK – met to discuss best practice in the diagnosis and treatment of malocclusion.

This document has been developed to advance the thinking of general dental practitioners (GPs) with the aim of broadening the conversations they have with their patients and encouraging them to assume responsibility for the monitoring and management of the occlusion.

The importance of prevention underpinned the day-long discussions.

The advent of new technology and new materials has transformed clinical practice in dentistry. It has taken time, however, for the teaching, regulation and practice of dentistry to keep pace with these advances, along with the evolving expectations and increased demands of patients.⁴

GPs are required to be competent in undertaking orthodontic assessments and providing clinical recommendations to patients.⁵ Patients should understand that their oral health incorporates their occlusion and the role it plays in their wellbeing.

As a consequence, GPs need to be educated as how best to assess and monitor patients, and plan treatment comprehensively. Early recognition and monitoring of a potential oral health problem means the optimal timing of any intervention, if one is required.

There are patients who attend the dentist for aesthetic treatment for whom improved oral health is also a benefit of treatment. At the other end of the spectrum, there are patients who attend due to a failing dentition for whom improved aesthetics could be a result.

Whatever the needs and expectations, patients should understand the all-encompassing nature of oral health. Ideally, patients who attend for a specific intervention should be educated on all aspects of their oral health, including their occlusion.

More patients than ever before are willing to have orthodontic treatment, from teenagers to octogenarians.⁶ According to the American Association of Orthodontists, one in four patients receiving treatment is an adult.⁷

section 1

DENTAL AESTHETICS

The concept of aesthetic dentistry (also known as esthetic dentistry) is relatively new. According to *The Principles and Practice of Esthetic Dentistry*,⁸ the movement dates back to the mid-1980s when dentistry moved from a needs-based service to a wants-based service: ‘...typically to maintain and, wherever possible, enhance oral health using minimal intervention approaches’.

The prospect of a smile makeover has raised patients’ expectations. Inspired by celebrity culture, patients desire a straighter, whiter, more harmonious smile and dentists working with skilled laboratory technicians are in a position to help patients achieve this. The advent of adhesive dentistry has also enabled elegant solutions to damaged dentitions.

According to the Working Group a difficulty in the past if teeth-straightening was required, was that many adult patients were, and remain, resistant to traditional fixed-brace orthodontics.

Previously, the solution for improving the position, alignment and shape of the teeth without traditional orthodontic treatment has been the application of veneers or crowns, both of which can damage tooth enamel and integrity, and have a limited lifespan.⁹

The members of the Working Group eschew the non-essential provision of dental crowns and veneers, the overuse of which has been referred to as 'porcelain pornography'.¹⁰

Less invasive solutions to tooth alignment, which provide a more predictable outcome, are preferred by GPs wanting to work ethically in the best interests of their patients.¹¹

In an article in *The Faculty Dental Journal of the Royal College of Surgeons*,¹¹ Professor Banerjee, an authority on the topic, stated: 'Minimum intervention care is the holistic oral healthcare team approach to help maintain long-term oral health with primarily prevention-focused, patient-centred care plans combined with the dutiful management of patients' expectations.'

The Working Group espouse a treatment philosophy that delivers a responsible, predictable, stable outcome. Underpinned by a detailed assessment of a patient's needs, a minimally invasive approach incorporates tooth movement when orthodontics is indicated.

Advances in aligner therapy have provided an appropriate alternative to traditional braces.¹² Patients wanting minimally invasive and aesthetic restorative procedures, such as cosmetic bonding or micro air-abrasion, are ready to embrace orthodontics as the first step in their restorative treatment. It is now common practice for tooth alignment to precede restorative dental work.¹³

According to the Working Group, patients are happy to accept aligner therapy combined with other restorative procedures, such as implants, cosmetic bonding or micro air-abrasion, veneers and bleaching.

section 2

MALOCCLUSION

According to Align Technology,¹⁴ 75% of the global population suffers from malocclusion and its prevalence is rising at a phenomenal rate.

Research that shows that there is improved oral health-related quality of life among young people who have orthodontics.¹⁵

The Group agreed that many adults have a malocclusion and are unaware of its impact on their overall health and wellbeing. Conversely, as described in **Box 1**, when malocclusion is addressed, the patient can experience a significant improvement in quality of life.¹⁶

Living with a malocclusion can have a negative impact on dental health and wellbeing. Malocclusion is linked to premature wear, tooth loss, gum disease and the build up of bacteria, which can result in other health-related issues – some texts have suggested a link with poor oral health and heart disease.¹⁷

When teeth are misaligned, it is more difficult to remove plaque and bacteria that can lead to inflamed and receding gums, soft tissue damage, pockets between teeth and gums,^{18,19} bone and tooth loss.

There is a positive correlation between orthodontics and improved oral hygiene.²⁰ When teeth are aligned, it is easier to brush between them, reducing the risk of developing pockets between teeth and gums and minimising build up of plaque and bacteria.²¹

A malocclusion, such as deep overbite or crossbite, can lead to excessive and uneven wear on individual teeth, leading to aesthetic and functional problems in the long term.²¹ At a functional level, it can cause teeth to be damaged by teeth in the opposing jaw. A deep overbite, a crossbite or an underbite can lead to teeth meeting unevenly, causing attrition.

By aligning teeth, the GP can create the optimum restorative environment.¹³ It may be possible to level gingival margins prior to treatment or, if the patient needs an implant, the GP can move the adjacent teeth to create the optimum space.

A stable occlusion can positively impact the long-term prognosis of treatment^{13,22} and provides the foundation for procedures, such as direct composite of veneers.

Box 1: Retrospective benefits of orthodontics

The benefits of orthodontics are often discovered retrospectively. Patients expect a straighter smile, what they don't expect is that another aspect of their physical, dental or emotional health, or even several aspects, could be improved, such as, anecdotally, their:

- » Improved oral hygiene
- » Improved bite
- » Reduction in prevalence of ulcers
- » Less jaw discomfort
- » Improved quality of life and wellbeing
 - › *Increased confidence in appearance*

“Many adults have a malocclusion and are unaware of its impact on their overall health and wellbeing.”

“You cannot underestimate the power of patients seeing their own teeth, or missing teeth, in full colour on the screen.”

Role of communication and digital technology

Advances in digital technology are key to better communication regarding a patient's oral health with regards to more efficient planning, reduced discomfort and treatment efficiency.

For GPs, digital scanning offers improved diagnosis, treatment planning and monitoring, reduced chair time and reduced treatment time – all of which, along with reduced anxiety related to pain, also benefit the patient.²³

In practices with a scanner, the patient can see their teeth and ask questions based on the visualisation. As a result, they are more likely to engage with proposals about their longer-term treatment. “You cannot underestimate the power of patients seeing their own teeth, or missing teeth, in full colour on the screen.”²⁴

Using an intraoral scanner, GPs can communicate to the patient the impact of continued attrition arising from a malocclusion, using visuals to aid the discussion. It is important that the GP explains that while currently the occlusion might be healthy and functional, it is dynamic and, therefore, teeth continue to move throughout life.

GPs who take the time to educate their patients will find their patients want to keep coming back.²⁵ However, with time allocated to initial consultations often limited, educating patients in the time available can be challenging.

Those GPs who invest time in a patient's initial assessment and who provide more information than might be expected, have an opportunity to build a relationship founded on trust.

Key to improved education and communication, and building a relationship is teamwork, with GPs needing to learn to use the skills of their wider team effectively.^{11,26}

The Working Group recommended that GPs who have team members with good communication skills should involve them in educating patients. Involvement from the wider team can free a dentist's time to focus on more complex cases, while still ensuring that appropriate level of education is being provided. As an example, the GP might spend 10 minutes with his/her patient and then assign a treatment coordinator to take over for the remainder of the appointment.

Another suggested approach is to introduce an initial screening appointment and then make the follow-up appointment to discuss the findings and develop a treatment plan. Co-diagnosis, in other words working with the patient to define the problems, can be powerful, the Working Group agrees.

It is important that GPs are trained in monitoring occlusion and communicating their findings to patients to ensure that the status of the occlusion is checked as part of a routine assessment, according to the Working Group.

Some GPs are of the mindset that orthodontics is mostly the work of orthodontists, with a tendency to focus only on the problem that the patient presents with.¹¹ A change in undergraduate dental degrees and behaviour are required to ensure that all GPs take a holistic view of their patients' needs.

According to the Working Group, the move towards responsible dentistry – where GPs view treatment comprehensively, including assessment of any tooth movement – is key to improving oral health outcomes for patients.

There should be an awareness of a GP's ethical duty to inform the patient about his/her oral health issues and what can be done to address areas of concern. If a patient is having difficulty cleaning his/her teeth, experiencing discomfort in bite, has excessive wear or has aesthetic issues, the GP has a responsibility to discuss interventions that could alleviate these issues.

The Working Group recognises that some GPs tend to diagnose within the confines of their own knowledge base, skills set and according to what they are comfortable with. As such, the group recommends that GPs are trained to diagnose and explain all aspects relating to a patient's oral health, stating that they should be able to diagnose malocclusion.

The treatment of malocclusion is an aspect of preventative dentistry.²⁷ However, it is not well understood or well explained to patients. The Working Group recommends that the definition of malocclusion, as well as the description of minimally invasive treatments, including the use of clear aligners, should be reviewed and improved in all languages, particularly online.

Due to the detrimental impact that malocclusion can have,¹ it should be addressed with patients who need to be aware of their condition. The Working Group states that earlier correction of a malocclusion is preferable: treatment is more predictable providing better outcomes and through more cost-effective options for the patient.

“The move towards responsible dentistry – where GPs view treatment comprehensively – is key to improving oral health outcomes for patients”

section 3

MALOCCLUSION AND ORAL HEALTH

The FDI policy statement¹ on oral health sets out the many implications of malocclusion on oral health. From a dental health perspective, Living with a malocclusion can have a negative impact on dental health.

Malocclusion in children is linked to premature wear, tooth loss, gum disease and the build up of bacteria which, in later life, can increase the risk of developing further health problems, including heart disease, stroke, lung disease, problems in pregnancy, complications related to diabetes and Alzheimer's disease.^{18,19,28,29}

Eating may be more difficult for patients whose teeth do not occlude properly and their teeth may be at greater risk of attrition while they may also be predisposed to temporomandibular joint (TMJ) dysfunction.³⁰ Stripping of the soft tissues of the mouth can be caused by a deep overbite and long-term dental problems may be caused by certain occlusal relationships.³⁰

Research shows that children and young people with overjet are more likely to suffer from trauma.³¹

There are multiple studies^{27,32} that suggest links between malocclusion and other oral health concerns, such as receding gums, gum disease, indentations at the gum line, cold sensitivity, chipped or fractured teeth and tooth loss.¹⁹ A systematic review³³ found a correlation between the presence of malocclusion and periodontal disease.

The impact of orthodontics on the health of the jaws should always be considered. With significant numbers of people suffering from stress and increased prevalence of malocclusion, temporomandibular disorder (TMD) is an issue that should be discussed at consultations, according to the Working Group. Patients should be told when they are suffering from traumatic occlusion or parafunction, and offered solutions.

Treating the malocclusion is a preventative treatment which would potentially improve the longevity of the dentition and make the teeth easier to clean.²⁷ While it is still possible to provide endodontic treatment for a patient with a severe malocclusion, access is easier, especially in the back molars, if the malocclusion has been addressed prior to treatment.³⁴

The Working Group agreed that tooth movement is the first stage of restorative treatment and that aligner therapy is the best choice for patients who are at risk of caries or periodontal disease.

Since patients can have predisposing factors for periodontal disease, care should always be taken with this cohort of patients. It stated that while orthodontic treatment is possible in this cohort, the mouth of the patient should be stabilised first. It is possible that orthodontic treatment might help with reducing recession and improving oral hygiene. Monitoring of the occlusion should be part of a person's life-long care profile, the group stated.

“Tooth movement is the first stage of restorative treatment and aligner therapy is the best choice for at-risk patients”

section 4

THE ROLE OF THE GP

Given the all-encompassing definition of oral health as set out in the foreword, a GP should be capable of diagnosing and treating a range of conditions from routine to complex. If the treatment is outside of their competency, the GP should refer the patient to a clinician who is suitably experienced.

Appropriate orthodontic referral will benefit the patient, give time back to care for the referring GP and enable the best use of available resources³⁵ with the priority being that the patient should be made aware of his/her oral health and what this means.

The Working Group recommended that the GP should not treat a tooth or a gum issue in isolation but take a comprehensive view of the patient's mouth. With appropriate training in treatment planning, they should be encouraged to focus on the final treatment outcomes.

Demand for orthodontic treatment is increasing.⁵ GPs have an opportunity to educate patients to understand the importance of a healthy occlusion and monitor the bite in the same way that they monitor for gum disease or check for oral cancer, according to the Working Group.

A small qualitative study in Australia³⁶ focusing on the provision of preventive care and advice, showed that the experience of having a dedicated, supportive and caring GP helped patients to take control of their oral health. Such GPs, according to the findings, are able to bring about profound changes in the way that a patient thinks about his/her oral health.

The Working Group states that the GP is often reluctant to talk about malocclusion, despite having a responsibility to educate their patients. The reasons are multi-factorial although time and money remain issues.

As a result of training, GPs are programmed to find a solution to the presenting problem rather than seeing the big picture. For example, a chipped tooth might be treated with some composite without the GP considering fully the aetiology, which could be traceable to a malocclusion.

GPs should be discouraged from trying to progress too rapidly with treatment; patients should be given time to reflect, with the Working Group actively recommending that patients should be encouraged to take time to think about the suggested treatment plan.

Further research into the relationship between malocclusion, and oral and general health should be undertaken.³ Support for GPs wanting to acquire confidence in using aligner therapy should not focus solely on successful case studies but on how to avoid mistakes, according to the Working Group.

GPs would benefit from tools to help them generate discussion, as well as support to ensure they are trained to understand the occlusion and its role in oral health, the group stated.

At the meeting, the Working Group developed checklists (See page 19) to help GPs at the crucial assessment stage.

section 5

CHALLENGES

Regulatory and governing bodies define how professionals should operate and their legal requirements may not always be conducive to progressive practice, which is in the best interests of patients.

The Working Group discussed specific examples, focusing on practice in France and the UK. In France, for instance, there is no recognition of the role of the hygienist, with the State Security system frustrating the aims of French clinicians wanting to develop a preventive practice.

In countries where state-funded dental care is available, the low fees attached to levels of care making it difficult for patients to understand the value of treatment, and educating them on the value of adopting comprehensive approach to oral health a challenge for GPs.

There are some critical challenges to overcome to build adoption of aligner therapy among the GP community. Dentists are often reluctant to start talking about tooth movement, and the reasons are multi-factorial. For some, it's a lack of confidence, according to the Working Group. Others fear rejection arising from the perception that they are selling to the patient.

As stated earlier in this document, the use of a scanner is perceived as invaluable in putting a proposed treatment into context, enabling the patient to better understand his/her oral health, through visualisation.

Having a passion for what you do is critical. Such passion can be cultivated with support from a mentor, which is viewed as very valuable by the Working Group, many of whom have been motivated and inspired by mentors. There was consensus among the group that passion needs to be matched by continued learning and development.

The length of time spent on learning orthodontics at dental school is highly variable, in some countries and dental schools, orthodontics is covered in just a few months and limited to traditional fixed braces. A study of undergraduate orthodontic training in UK dental schools³⁷ found a wide variation in hours and content.

By contrast and by way of example, in the UK an orthodontic specialist trains for a further two to three years after graduating from dental school.

There is a lot of work to be done in educating the GPs on:

- Clinical diagnosis and treatment
 - » Importance of clear diagnosis, including the aesthetics aspects (face, soft and hard tissues), function (static and dynamic occlusion), structural and biological aspects and explanation of it
 - » Provision of treatment options to empower the patient
 - » Importance of monitoring patients – so that they understand that their dentition is dynamic
 - » When to refer.
- Patient management
 - » Appreciation of the role of the occlusion in patients' overall wellbeing
 - » Willingness to take time with patients.
- Comprehensive dentistry as responsible dentistry
 - » Ethics and the role GPs have in providing a comprehensive oral health assessment
 - » Removing the fear of rejection with regards to being seen as trying to 'sell' a treatment option.

“The use of a scanner is perceived to be invaluable in putting a proposed treatment into context, enabling the patient to better understand his/her oral health”

section 6

ALIGNMENT CARE PATHWAY WORKSHOP

In order to support GPs, the Working Group devised an alignment care pathway (pages 20-21). Before embarking on a pathway, a series of questions should be asked, which vary according to whether the patient's needs are restorative, periodontal or prosthetic.

It is important to note that consideration should always be given to the patient's expectations, motivation and willingness to follow oral hygiene instructions. A psychological assessment is essential to ensure that patients are appropriate candidates for treatment.

Checklist 1: When treating a patient requiring restorative work, will alignment deliver the following?:

1. Reduce the amount of tooth preparations/restorations on fewer teeth
2. Improve aesthetic result
3. Improve function
4. Improve longevity
5. Improve stability
6. Improve gingival margins.

Checklist 2: When treating a patient requiring prosthetic work, will alignment:

- 1-4. As above
5. Reduce the amount of preparations/restorations
6. Improve aesthetic result
7. Improve function
8. Improve longevity

Plus, will it help either:

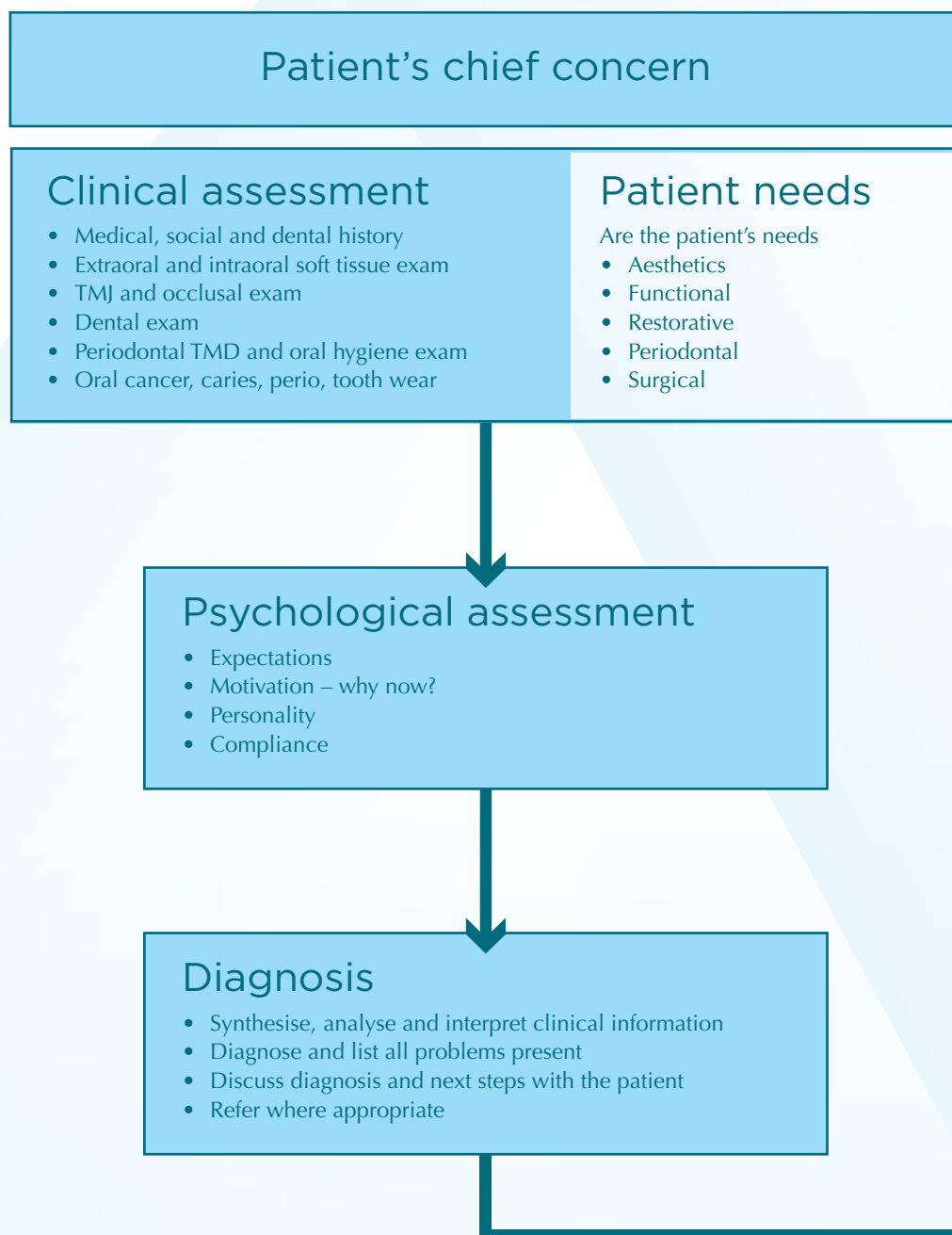
- Provide stability of prosthesis
- Create space for an implant.

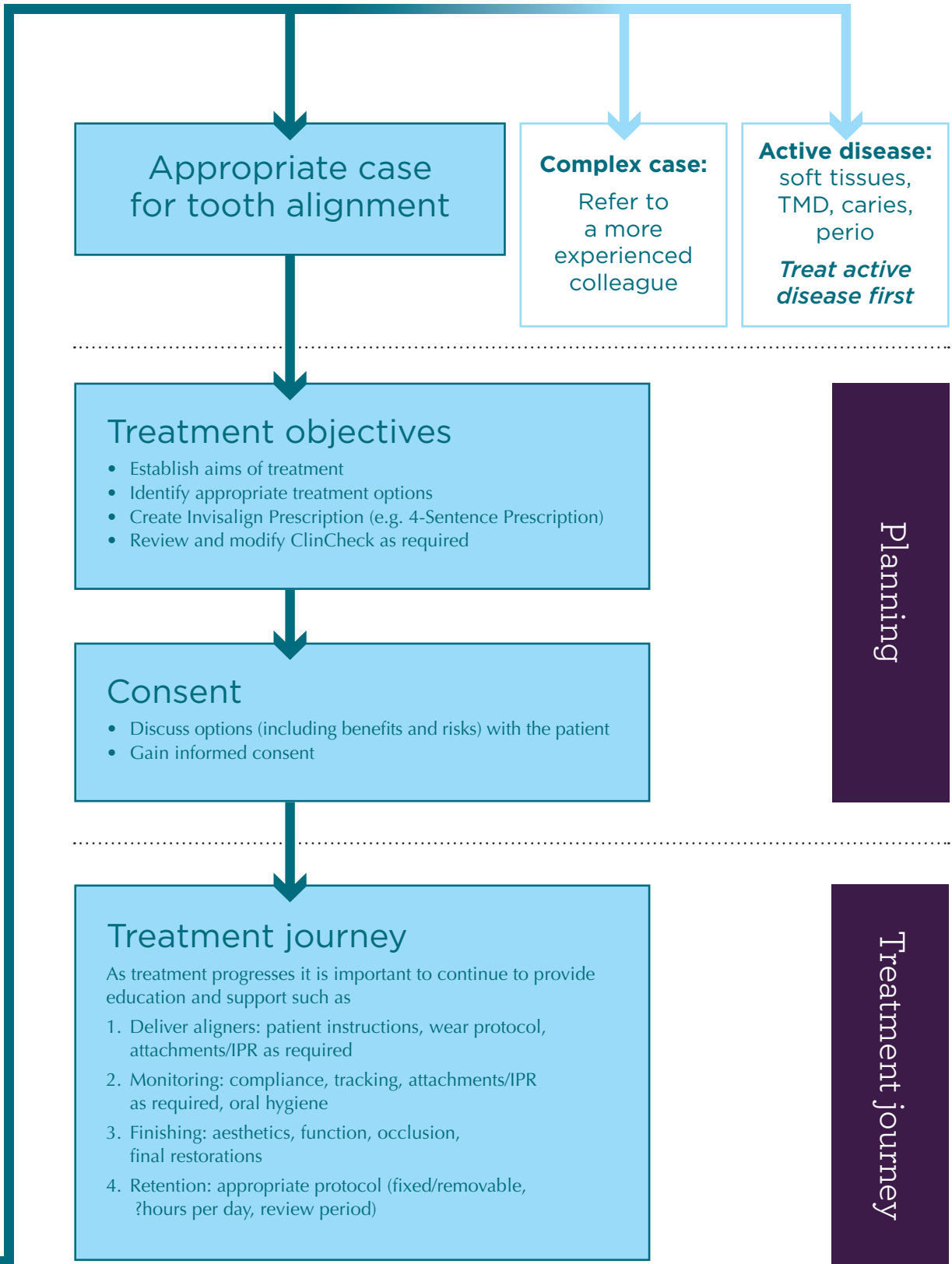
Checklist 3: When treating a patient with a periodontal condition, will alignment:

1. Improve ability to manage oral hygiene, brush and floss
2. Improve attachment level
3. Improve occlusal forces
4. Reduce recession
5. Improve aesthetics
6. Simplify and limit gingival surgery
7. Improve emergence profile.

Tooth alignment treatment pathway

Assessment & diagnosis





section 7

INVISALIGN

Clear aligner therapy has been a part of orthodontic practice for decades, but has, particularly since the introduction of Invisalign clear aligner therapy in 1998, become an increasingly common addition to the orthodontic armamentarium.³⁸

The differences between these appliances are profound which makes the choice of a specific appliance a critical decision determined by the severity of the malocclusion, the ability of the doctor to influence the final outcome, the speed and utility of the clinical treatment, and appliance aesthetics and comfort.³⁸

Invisalign treatment is perceived to have the following advantages:

For dentists:

- Enables GPs to meet the evolving expectations of patients by being able to offer alternatives to traditional interventions, for example, fixed braces⁴
- Can be integrated into comprehensive treatment plans, which help patients to visualise their treatment journey
- Provide GPs with the precision and control to deliver more predictable results³⁹
- Enables GPs to control the amount of force and which teeth to move and the time of sequencing
- Provides GPs with an appropriate option for patients who are at high risk of caries or periodontal disease and would benefit from improved oral hygiene^{40,40}
- Aligners can be used to facilitate reattachment of the periodontal ligament (PDL)
- Provides access to education with a clear roadmap of training, relevant clinical education and support.

“Invisalign makes us better dentists in that we can pre-align teeth and not make compromises and it makes us responsible dentists.”

For patients:

- Enables patients greater control over plaque and makes flossing easier when compared to fixed braces⁴⁰
- Can be removed making it easier to clean teeth and reducing the risk of tooth decay or decalcification
- Provides more predictable outcomes³⁹
- The digital treatment plan enables patients to visualise the treatment journey and the predicted outcomes^{34,39}
- Clear aligners are discreet and comfortable
- By wearing aligners 20–22 hours a day, patients become more dentally aware and, therefore, often more dentally healthy⁴¹
- Continuity of care.

section 8

CONCLUSIONS

The burden of malocclusion is real – 75% of the global population suffer from it¹⁴ – and its prevalence continues apace.

The GP plays a crucial role in diagnosing, treating, monitoring and educating patients²⁵ on how best to treat malocclusion and manage oral health – a key indicator of overall health, wellbeing and quality of life.

Advances in technology and evolving patient demands and expectations⁴ have dramatically altered the dental care landscape.

These advances have resulted in the proliferation of less invasive solutions that provide more predictable outcomes in tooth movement³⁹ delivered in a multidisciplinary healthcare setting.

While treatment of malocclusion is a core tenet of preventative dentistry, it is not well understood or well explained to patients. This is an area the Working Group believes should be addressed beginning with a review of the definition of malocclusion, along with the description of minimally invasive treatments, in all languages.

Education of GPs is key to ensuring that malocclusion is better understood, treated and managed, to ensure better oral health.

There is a lot of work to be done to further educate GPs on:

- Appreciation of the role of the occlusion in patient wellbeing
- Patient management
 - » Willingness to take time with patients
- Importance of monitoring patients – so that they understand that their dentition is dynamic
- Removing the fear of rejection
- The role of aligner therapy in minimising compromised treatment.

Both the WHO and the FDI emphasise that the GP has responsibility for oral health. The Working Group believes these definitions of oral health should be more widely communicated.

Since many patients seek treatment for aesthetic reasons, often just for the social six, it's important to communicate the added benefits of Invisalign treatment to the patients.

There is much that can be done to help educate GPs.

Consensus statements to emerge from the summit:

- Responsible dentistry is comprehensive dentistry
- Aligning teeth offers the optimum restorative environment
- Co-diagnosis can be powerful
- GPs can, and should where possible, involve team members in informing and educating patients
- The scanner is an invaluable patient communication tool and enables GPs to store and share information to validate treatment plans. It helps to improve quality and precision and reduce costs⁴²
- Invisalign and minimally invasive dentistry are in the best interests of patients.

“GPs need the tools to generate awareness (among patients) around better health, better comfort and better function. GPs want to be able to start a conversation – perhaps a pre-examination questionnaire would be useful?”

References

1. World Dental Federation. FDI's definition of oral health. <https://www.fdiworlddental.org/oral-health/fdi-definition-of-oral-health> [Accessed February 7, 2020]
2. World Health Organisation. Oral Health https://www.who.int/health-topics/oral-health/#tab=tab_1 [Accessed February 7, 2020]
3. World Dental Federation. Malocclusion in orthodontics and oral health <https://www.fdiworlddental.org/resources/policy-statements/malocclusion-in-orthodontics-and-oral-health> [Accessed February 7, 2020]
4. The Guardian. Look who's smiling. <https://www.theguardian.com/society/2009/aug/08/dentists-earnings-nhs-private-practice> [Accessed December 2017].
5. Jawad Z, Bates C, Hodge T. Who needs orthodontic treatment? Who gets it? And who wants it? *British Dental Journal* 2015;218:99–103.
6. British Orthodontic Society. BOS Statements: Claims about orthodontics <https://www.bos.org.uk/News-and-Events/BOS-Statements/BOS-Statements-Claims-about-orthodontics> [Accessed February 7, 2020]
7. American Association of Orthodontists. Adults guide to orthodontics 2019 https://www.aaoinfo.org/_/adult-orthodontics/ [Accessed February 7, 2020]
8. *Principles and Practice of Esthetic Dentistry: Essentials of Esthetic Dentistry*. Edited Wilson NHF and Millar BJ. Elsevier 2015 [<https://www.sciencedirect.com/book/9780723455585/principles-and-practice-of-esthetic-dentistry>]
9. Alani A, Kelleher M, Hemmings K, Saunders M, Hunter M, Barclay S. Balancing the risks and benefits associated with cosmetic dentistry – a joint statement by UK specialist dental societies. *Br Dent J* 2015; 218(9):543–8.
10. Kelleher M. Poreclain pornography. *FDJ* 2011; 2(3):134–41 <https://publishing.rcseng.ac.uk/doi/10.1308/204268511X13064036474003?mobileUi=0> [Accessed February 7, 2020]
11. Banerjee A.(2015).The contemporary practice of minimally invasive dentistry. *Faculty Dental Journal* 2015; 6(2):78–85 <https://publishing.rcseng.ac.uk/doi/pdfplus/10.1308/204268515X14174408396163> [Accessed February 7, 2020]
12. Align Technology Data on file at Align Technology as of September 20, 2017. Based on survey data of current dental practitioners in the U.S. Doctors (n=251) were asked, "What percent of the patient cases for prosthodontic procedures (i.e., veneers, implants, bridges, partials) would have benefitted from a better initial position of the teeth?" An average of 45% was calculated from the doctors' responses.
13. Reikie D. Orthodontically Assisted Restorative Dentistry. *J Can Dent Assoc*; 2001;67(9):516–20.
14. Fortune Business Insights. *Clear aligners market size, share and industry analysis by patient age group (teenage, adults) by end-user (hospitals, dental and orthodontic clinics) regional forecast 2019–2026* <https://www.fortunebusinessinsights.com/industry-reports/clear-aligners-market-101377> [Accessed February 2, 2020]
15. Javidi H, Vettore M, Benson P. Does orthodontic treatment before the age of 18 years improve oral health-related quality of life? A systematic review and meta-analysis. *American Journal of Orthodontics and Dentofacial Orthopedics* 2017;151(4):644–55.
16. Silvola et al. (2014). *Dental Esthetics and Quality of Life*, 2014;84(4), pp. 594–9.
17. Shmerling RH. *Gum disease and the connection to heart disease*. Harvard Health Publishing. Harvard Medical School. April 2018. <https://www.health.harvard.edu/diseases-and-conditions/gum-disease-and-the-connection-to-heart-disease> [Accessed March 27, 2020]
18. Chung CH, Vanardall RL, Cavalcanti EA, Baldinger JS, Lai CH. Comparison of microbial composition in the subgingival plaque of adult crowded versus non-crowded dental regions. *Int J Adult Orthodon Orthognath Surg* 2000, Winter; 15(4):321–30
19. Stauer K & Landmesser H. Effects of crowding in the lower anterior segment – a risk evaluation depending upon the degree of crowding. *Journal of Orofacial Orthopedics* 2004; 65:13–25.
20. Ngom PL, Benoist HM, Thiam F, Diallo PD. Influence of orthodontic anomalies on periodontal condition. *Odontostomatol Trop* 2007 June;30(118):9–16. <https://www.ncbi.nlm.nih.gov/pubmed/17933356/>

21. Boke F, Gazioglu C, Akkaya S, Akkaya M. Relationship between orthodontic treatment and gingival health: A retrospective study. *Eur J Dent* 2014 Jul–Sep;8(3):373–80. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4144137/> [Accessed March 25, 2020]
22. Davies S and Gray R. What is occlusion? *Br Dental J* 2001;191:235–8.
23. Baheti MJ. Intra-oral Scanners: a new eye in dentistry. *Journal of Orthopedics and Rheumatology* 2015; 2(3):1021
24. White M. The inevitable march of intra-oral digital scanning. *Br Dent J* 2019;226 <https://doi.org/10.1038/s41415-019-0185-y> [Accessed February 2, 2020]
25. Singh S. How to keep your patients coming back to your clinic. *Dentistry.co.uk*. February 16, 2018 <https://www.dentistry.co.uk/2018/02/16/keep-patients-coming-back-clinic/> [Accessed February 7, 2020]
26. Gkantidis N, Christou P, Topouzelis N. The orthodontic–periodontic interrelationship in integrated treatment challenges: a systematic review. *J Oral Rehabilitation* 2010; 37:377–90.
27. Mourad S, Abidine Z, Laslami N, Bentahar Z. Periodontal health and orthodontics. Chapter 32. *Emerging trends in Oral Health Sciences and Dentistry*. IntechOpen. 2015 Croatia.
28. Nesse W, Dijkstra PU, Abbas F, Spikervet FKL, Stijger A, Tromp JAH, van Dijk JL, Vissink A. Increased prevalence of cardiovascular and autoimmune diseases in periodontitis patients: a cross-sectional study. *Journal of Periodontology* November 2010; 81(11):1622–28.
29. Whiteman H. Alzheimer’s disease linked to poor dental health. *Medical News Today*, July 31, 2013 [Accessed February 24, 2020]
30. Roberts-Harry D, Sandy J. Orthodontics. Part 1. Who needs orthodontics? *Br Dent J*, 2003;195:433–7.
31. Norton E and O’Connell AC. Traumatic dental injuries and their association with malocclusion in the primary dentition of Irish children. *Dental Traumatology* 2012;28:81–6. <https://doi:10.1111/j.16000-9657.2011.01032.x> [Accessed March 26, 2020]
32. Gusmão ES, de Queiroz DC, de Souza Coehlo R, Cimões R, dos Santos RL. Association between malpositioned teeth and periodontal disease. *Dental Press J Orthod* 2001 July–Aug;16(4):87–94.
33. Bollen A. Effects of malocclusions and orthodontics on periodontal health: evidence from a systematic review. *J Dent Educ* 2008;72(8):912–8.
34. Patel ND. *Effect of aligner material, duration and force level on tooth movement*. Master of Science Thesis. University of Florida, 2014. Presented by Dr Tim Wheeler, AAO, 2014.
35. Dowsing P & Sandler J. A guide to making appropriate orthodontic referrals. *Dental Update* June 7, 2017; 34(8):487–91.
36. Sbarani A, Carter SM, Wendell Evans R, Blinkhorn A. Experiences of dental care: what do patients value? *BMC Health Serv Res* 2012; 12:177 <https://doi.org/10.1186/1472-6963-12-177> [Accessed February 7, 2020]
37. Derringer KA. Undergraduate orthodontic teaching in UK dental schools. *Br Dent J* 2005 Aug 27;199(4):224–32. <https://doi:10.1038/sj.bdj.4812615> [Accessed March 25, 2020]
38. Weir T. Clear aligners in orthodontic treatment. *Australian Dental Journal* 2017;62(1 suppl):58–62. <https://onlinelibrary.wiley.com/doi/epdf/10.1111/adj.12480> [Accessed April 24, 2020]
39. Miethke RR, Vogt S. A comparison of the periodontal health of patients during treatment with the Invisalign system and with fixed orthodontic appliances. *J Orofac Orthop*, 2005 May; 66(3):219–29.
40. Levrini L, Mangano A, Montanari P, Margherini S, Caprioglio A, Abbate GM. Periodontal health status in patients treated with Invisalign® system and fixed orthodontic appliances: A 3 month clinical and microbiological evaluation. *Eur J Dent*, 2015;9(3), pp.404–10.
41. Azaripour A, Weusmann J, Mahmoodi B et al. Braces versus Invisalign®. Gingival parameters and patients’ satisfaction during treatment: A cross-sectional study. *BMC Oral Health*, 2015; 15(69)
42. Joda T and Brägger U. Patient-centred outcomes comparing digital and conventional implant impression procedures: a randomised crossover trial. *Clinical Oral Implants Research*, April 2015; 27(12):e185–e189. <https://doi.org/10.1111/clr.12600>

The diagnosis and treatment of malocclusion
Best Practice Statement
London: Page & Page, 2020



align