Sodobne tehnologije omogočajo načrtovanje in izdelavo opornic za zdravljenje položajnih nepravilnosti zob

Modern technologies enable treatment planning and the fabrication of clear aligners for the correction of misaligned teeth

Avtor / Author

Ustanova / Institute

Anita Fekonja[1, 2], Nejc Rošer[3], Igor Drstvenšek[4]

[1]Zdravstveni dom dr. A. Drolca Maribor, Specialistična ortodontska ambulanta, Ulica talcev 9, 2000 Maribor, Slovenija; [2]Univerza v Mariboru, Medicinska fakulteta, Taborska 8, 2000 Maribor, Slovenija; [3]Interesansa – Inštitut za razvoj in izdelovalne tehnologije, Teslova ulica 27, 1000 Ljubljana, Slovenija; [4]Univerza v Mariboru, Fakulteta za strojništvo, Smetanova ulica 17, 2000 Maribor, Slovenija;

[1]Healthcare Centre dr. A. Drolc Maribor, Department of Orthodontics, Ulica talcev 9, 2000 Maribor, Slovenia; [2]University of Maribor, Faculty of Medicine, Taborska 8, 2000 Maribor, Slovenia; [3]Interesansa – Institute for Production Technologies and Development, Teslova 27, 1000 Ljubljana, Slovenia; [4]University of Maribor, Faculty of Mechanical Engineering, Smetanova 17, 2000 Maribor, Slovenia;

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Izvleček

Namen: *Namen prispevka je predstaviti možnost poravnave zob z estetskimi prozornimi opornicami, ki jo omogoča tehnologija, v celoti izvedena v Sloveniji.*

Poročilo o primeru: *34-letni pacient je obiskal specialistično ambulanto zaradi nepravilnega položaja zob v spodnji čeljustnici. Cilj zdravljenja je bil poravnati zobe v spodnjem zobnem loku z uporabo prozornih opornic, izdelanih v Sloveniji. Postopek smo začeli s kakovostnim odtisom za delovni model. Delovni model smo skenirali in tako v računalniku ustvarili 3D različico pacientovih zobnih lokov in griza. S pomočjo programske opreme smo izdelali 3D navidezni model in na njem*

Abstract

Purpose: *This article reports the realignment of teeth with clear aligners (CA) made using a modern technique manufactured entirely in Slovenia.*

Case report: *A 34-year-old man visited the Orthodontic Department of our healthcare centre because of misaligned teeth in the mandibular arch. The goal of treatment was to align the mandibular anterior teeth using a Slovenian-made CA. The procedure began with an impression for the working cast that was scanned and a 3D image of the patient's dental arches and occlusion were created in the computer. A software package was used to create a 3D virtual model,*

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Naslov za dopisovanje / Correspondence
Doc. dr. Anita Fekonja, dr. dent. med., Zdravstveni dom dr. A. Drolca Maribor, Specialistična ortodontska ambulanta, Ulica talcev 9, 2000 Maribor, Slovenija
Telefon: +386 41 453 142
E-pošta: anita.fekonja1@guest.arnes.si

zobe premaknili v želen (optimalen) položaj, ki naj bi ga dosegli z opornicami. Opornice smo izdelali iz termoplastičnega materiala (poliuretan) s termo-formiranjem, in sicer s pomočjo modela, izdelanega z laserskim sintranjem. Pacient je prejel navodila o 22-urni dnevni nošnji, vsako opornico zamenja po 2 tednih. Obravnava je trajala 6 mesecev. Ob koncu zdravljenja je bil nameščen fiksni retencijski lok za stabilizacijo in preprečitev recidiva. Pacient je z rezultatom bil zelo zadovoljen. Dve leti po zaključenem zdravljenju stanje ostaja nespremenjeno in stabilno.

Zaključek: *Zdravljenje s prozornimi opornicami je v primerjavi s klasičnimi fiksnimi aparati snemljiva tehnika, ki zagotavlja boljšo estetiko, večje udobje, omogoča boljše vzdrževanje higiene.*

and the teeth were virtually placed in the positions that would be achieved during treatment with the CA. The CA were made of an elastic thermoplastic material (polyurethane). The patient was instructed to wear the appropriate aligner for 22 hours daily and change it every two weeks. Dental crowding was corrected in six months and at the end of treatment a lingual fixed retainer was bonded to prevent relapse. The patient was very satisfied with the result. After two years of retention, the results remain stable.

Results: *Comparable to a conventional fixed appliance, a CA is a removable device that offers better aesthetics, more comfort and better oral hygiene.*

INTRODUCTION

Additive manufacturing (AM) is the term used to describe technologies for creating 3D objects by depositing material layer by layer, be it plastic, metal, concrete, or one day, human tissue. Common to all AM technologies is the use of a computer, 3D modelling software (Computer Aided Design or CAD), machine equipment and material for deposition. Once a CAD sketch is created, the AM machine reads the data from the CAD file and deposits layer upon layer of liquid, powder, sheet material or other materials to produce a 3D object (1, 2).

Recently, AM has been used for the production of medical implants, tools, and dentures, and also in orthodontics (3-7). Clear aligner treatment is already well known in orthodontics, but it is limited to a small number of companies offering this type of treatment (8, 9).

In this article we present an example of successful treatment with clear aligners (CA) made entirely in Slovenia. To our knowledge this is the first report of treatment planning and production of CA in Slovenia.

CASE REPORT

A 34-year-old man with permanent dentition visited the Orthodontic Department of our healthcare centre with the complaint that his lower anterior teeth were crowded. Intraoral examination revealed a Class I relationship and crowding of the mandibular anterior teeth. There was a mild lack of space of 3.5 mm (Figure 1). The goal of treatment was to align the mandibular teeth using clear aligners (CA). The process began with taking a high-quality impression for the working cast. A high-quality impression requires a clear surface of the teeth, no voids, no pulls or visible areas of the tray. We used alginate to take the impression. The working cast was then scanned with a 3D optical

Figure 1. *Crowded lower anterior mandibular teeth before treatment*

Figure 2. *3D image of the patient's mandibular arch*

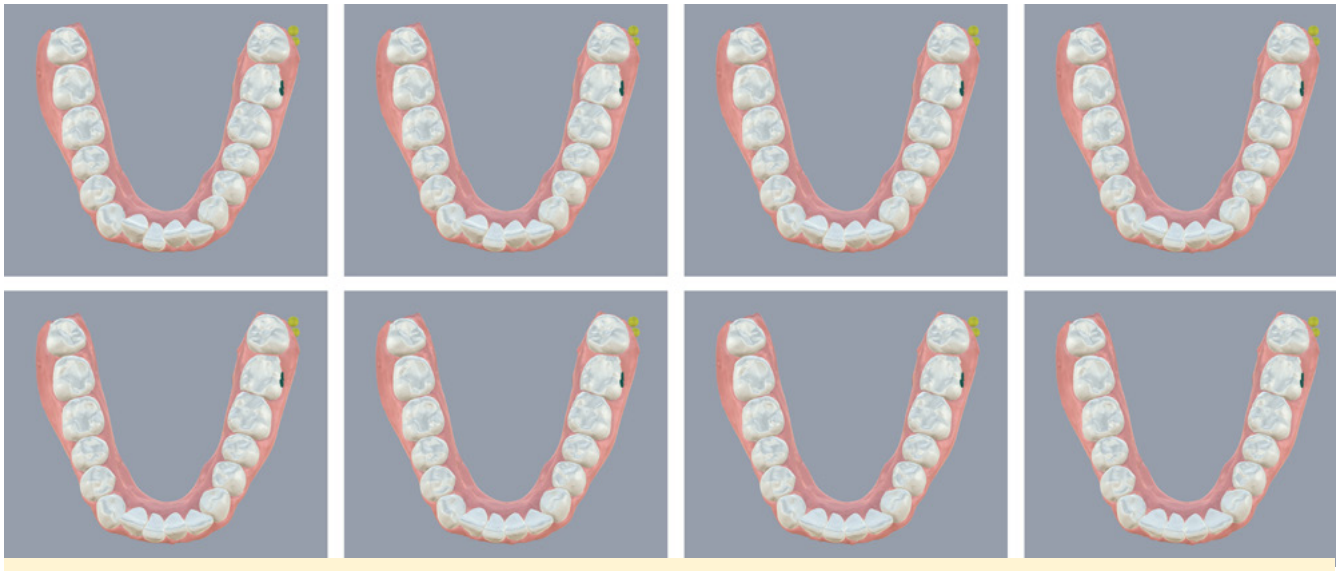

Figure 3. *Stages between the current and desired tooth positions.*

Figure 4. *CA made from an elastic thermoplastic material*

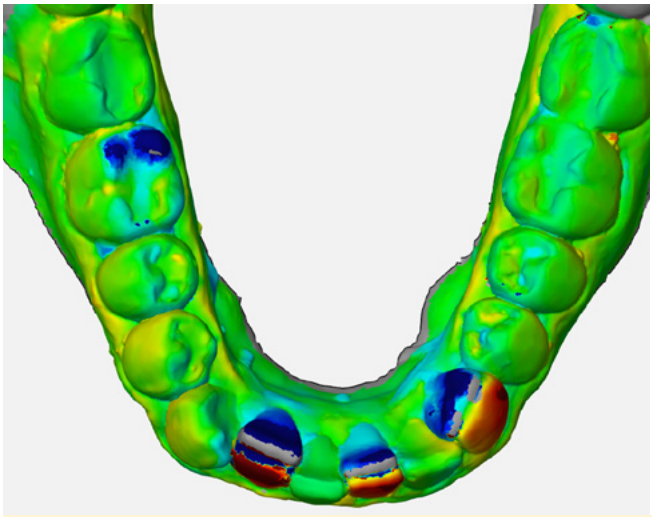

Figure 5. *The position changes of the mandibular anterior teeth; the posterior teeth remain almost unchanged.*

Figure 6. *Lower dental arch after treatment with clear aligners (CA).*

scanner (3Shape, Copenhagen, Denmark) and a 3D model of the patient's dental arches and occlusion was created in the computer. A software package (Maestro 3D (AGE Solutions s.r.l., Pisa, Italy) was used to create a 3D virtual model (Figure 2). At this stage, the teeth were virtually moved to the desired positions to be achieved with the CA treatment. We decided to use slow tooth movement (linear movement 0.25 mm, angular movement 3°). The software program automatically defines the steps between the current and the desired tooth positions, and creates models for fabrication of CA specifically for that patient (Figure 3). Therefore, the number of CA depends on the complexity of the required movements. The CA were made of an elastic thermoplastic material (polyurethane) (Figure 4) by thermoforming it over the model made by laser sintering (EOSINT P395 (EOS, Krailing, Germany). The aligners apply pressure to the teeth to move them into the position of the aligner (Figure 5). The CA treatment for the patient comprised eight lower CA. The patient was instructed to wear each CA for 22 hours a day for two weeks. The patient took them out only for eating, drinking, and brushing or flossing the teeth. After four months (eight CA) of initial treatment, a Case Refinement with two more CA was required to complete the alignment of the teeth. At the end of the course of treatment, the dental crowding was corrected (Figure 6) and the active treatment period was completed in six months with ten aligners. At the end of treatment, a fixed lingual retainer was placed to prevent relapse. The patient was very satisfied with the result. After two years of retention, the results remain stable.

DISCUSSION

Many different techniques, prescriptions and materials can be used to correct malocclusions (10). In recent years, aesthetic and discrete appliances have become popular and there seems to be a constant search for new materials and techniques that can achieve similar orthodontic results (11). Over the past 20 years, CA treatment has evolved from a technique for treating only mild malocclusion to one that allows for the treatment of almost all types of orthodontic problems. However, it is important to know the limitations of these appliances and to take them into account when planning treatment (12).
The most popular and well-known CA are Invasilign, Orthocaps, Ortoclear, and Clear correct. In this article we report treatment of a patient with CA which were completely made in Slovenia. These aligners can be made individually for each patient, and are based on the severity of the tooth misalignment.

CONCLUSIONS

New materials and contemporary techniques are revolutionizing modern orthodontics by reducing treatment and chair time, minimizing discomfort and optimizing aesthetics.
The demand for high-quality and aesthetic orthodontic treatment has increased significantly. Digitalization, advanced technologies for the production of 3D objects and the relevant knowledge make it possible to create CA and carry out a successful treatment.

CONFLICT OF INTEREST

The authors have no conflicts of interest.

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