UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEARCORRECT OPERATING, LLC

Petitioner,

v.

ALIGN TECHNOLOGY, INC.

Patent Owner.

Case IPR2017-01829

U.S. Patent No. 8,038,444

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,038,444 UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104

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1007	Biggerstaff, R.H., *Computerized Diagnostic Setups and Simulations*, Jan. 1970.
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1015	U.S. Patent No. 4,478,580 to Barrut
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1019	Stoker, N. G., et al. "Stereolithographic Models for Surgical Planning: Preliminary Report." *J Oral Maxillofac Surg*. 50:466-471 (1992)
1020	Fuhrmann, R. A. W., et al. "Treatment Prediction with Three-Dimensional Computer Tomographic Skull Models." *Am J Orthod Dentofac Orthop*. 106:156-60 (1994)
1021	Cacciafesta, V., et al. "Bending Art System – State of the Art and First Impressions." *Kieferorthop*. 9:247-254 (1995)
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1023	Kesling, H. D. "The Philosophy of the Tooth Positioning Appliance." *Am J Orthod Oral Sur*. 31(6):297-304 (1945)
1024	Kesling, H. D. "The Diagnostic Setup with Consideration of the Third Dimension." *Am J Orthod*. 42(10):740-748 (1956)
1025	Elsasser, W. A. "Some Observations on the History and Uses of the Kesling Positioner." *Am J Orthod*. 136(5):368-374 (1950)
1026	*Ormco Corp. v. Align Technology, Inc.*, 463 F.3d 1299, 1306 (2006)
1027	Bunch, W. B. "Orthodontic Positioner Treatment During Orthopedic Treatment of Scoliosis." *Am J Orthod*. 47(3):174-204, 196 (1961)

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1031	Gottlieb, E. L. et al. "JCO Interviews Dr. James A. McNamara, Jr., on the Frankel Appliance, Part 2: Clinical Management." *J Clin Orthod*. 16(6), 390-407 (1982)
1032	Nahoum, H. I., "The Vacuum Formed Dental Contour Appliance," *The New York State Dental Journal*, 30(9):385-390 (1964)
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1039	Parkhouse, R. C. "Rectangular wire and third-order torque: A new perspective." *Am. J. Orthod. Dentofacial Orthop*. 113(4):421-430 (1998)
1040	Wainwright, W. M. "Faciolingual tooth movement: Its influence on the root and cortical plate." *Am. J. Orthod*. 64(3):278-302 (1973)

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I. INTRODUCTION

ClearCorrect Operating, LLC ("ClearCorrect" or "Petitioner") requests that the Board institute *inter partes* review of U.S. Patent No. 8,038,444 ("'444 patent," Ex. 1001) in accordance with 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.100 et seq.

The claims of the '444 patent are directed to a widespread and common notion: generating an optimal orthodontic treatment path for use with clear, plastic "aligners." This process has been commercialized by several entities, including patent owner, Align, Inc. ("Align"). But, this entire concept is simply based on age-old methods of manually generating treatment options by producing modified tooth arrangements on physical casts and fabricating corresponding dental incremental position adjustment appliances—methods known for almost an entire century, at least since the 1940's. With the passage of time and the advent of modern computer technology, the manual methodology was replaced by an automatic digital and mechanical means for accomplishing the same result. Numerous prior art references—notably, several of Align's own patents—describe techniques for digitally rendering orthodontic 3D models, determining treatment paths, and providing a visual display of the teeth along different treatment paths, even in the precise terms of the '444 patent. Hence, it is clearly evident that the '444 patent was improvidently granted.

The charts in Section VII demonstrate that claims 1-42 of the ’444 patent are unpatentable over Align’s own prior art, and that Petitioner has a reasonable likelihood of prevailing with respect to the same.

II. MANDATORY NOTICES

Petitioner respectfully requests review for claims 1-42 of the ’444 patent in accordance with 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.100 *et seq*. Pursuant to 37 C.F.R. § 42.8(a)(1), Petitioner provides the following mandatory disclosures.

A. Real Party-In-Interest

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner certifies that ClearCorrect Operating is the real party-in-interest, and the parent company of ClearCorrect Operating is ClearCorrect Holdings, Inc.

B. Related Matters

There are no pending related matters involving the ’444 patent.

C. Lead and Back-Up Counsel

Pursuant to 37 C.F.R. § 42.8(b)(3), Petitioner provides the following designation of counsel:

Lead counsel is Scott A. McKeown (Reg. No. 42,866) and back-up counsel is Lisa Mandrusiak (Reg. No. 72,653).

D. Service Information

Pursuant to 37 C.F.R. § 42.8(b)(4), papers concerning this matter should be served in accordance with the following.

Address:	Scott McKeown or Lisa Mandrusiak
	Oblon, McClelland, Maier & Neustadt, LLP
	1940 Duke Street
	Alexandria, VA 22314
Email:	cpdocketmckeown@oblon.com
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Petitioner consents to service by email.

III. PAYMENT OF FEES

The undersigned authorizes the Office to charge the fee required by 37 C.F.R. § 42.15(a) for this Petition for *inter partes* review to Deposit Account No. 15-0030. Any additional fees that might be due are also authorized to be deducted from Deposit Account 15-0030.

IV. REQUIREMENTS FOR *INTER PARTES* REVIEW

As set forth below and pursuant to 37 C.F.R. § 42.104, each requirement for IPR of the '444 patent is satisfied.

A. Grounds for Standing

Pursuant to 37 C.F.R. § 42.104(a), Petitioner certifies that the '444 patent is available for IPR and that Petitioner is not barred or estopped from challenging the claims of the '444 patent on the grounds identified herein. None of Petitioner, Petitioner's real party-in-interest, or Petitioner's privies have been served with a complaint alleging infringement of the '444 patent.

B. Claims For Which Review is Requested and Statutory Grounds

Pursuant to Rule 42.104(b), Petitioner requests IPR of claims 1-42 of the '444 patent, and that the Board cancel the same as unpatentable in view of the following references:

Ex. 1004 – U.S. Patent No. 6,729,876 to Chishti et al. ("Chishti '876") issued on May 4, 2002, more than one year prior to the earliest filing date of the '444 patent. Therefore, Chishti '876 is prior art under 35 U.S.C. § 102(b). Chishti '876 was not substantively considered during the prosecution of the '444 patent, nor is it cumulative of any prior art considered by the examiner.

Ex. 1005 – U.S. Patent No. 6,471,511 to Chishti et al. ("Chishti '511") issued on Oct. 29, 2002, more than one year prior to the earliest filing date of the '444 patent. Therefore, Chishti '511 is prior art under 35 U.S.C. § 102(b). Chishti '511 was not substantively considered during the prosecution of the '444 patent, nor is it cumulative of any prior art considered by the examiner.

The grounds of unpatentability presented are as follows:

i. Claims 1-42 are unpatentable under 35 U.S.C. § 103(a) based on Chishti ’876; and

ii. Claims 1-42 are unpatentable under 35 U.S.C. § 103(a) based on Chishti ’511 in view of Chishti ’876.

This Petition is supported by the Declaration testimony of Dr. James Mah, which describes the scope and content of the prior art at the time of the application of the ’444 patent. (*See* Ex. 1003.)

Pursuant to Rule 42.204(b)(4), an explanation of how claims 1-42 of the ’444 patent are unpatentable, that the Petitioner has at least a reasonable likelihood of prevailing on these grounds, including identifying where each element of the claim is found in the prior art, is provided in Section VII below. Pursuant to Rule 42.204(b)(5), the exhibit numbers of the supporting evidence relied upon to support the challenges and the relevance of the evidence to the challenges raised, including identifying specific portions of the evidence that support the challenges, are provided in Section VII below.

V. FACTUAL BACKGROUND

A. Level of Skill in the Art

The level of skill in the art is generally evidenced by the prior art references. The level of ordinary skill in the art is evidenced by the prior art. *See In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (the Board did not err in adopting the approach that the level of skill in the art was best determined by the references of record). Based on the references, it is likely that a POSITA would have a doctorate in dental science and three to five years of training and practical experience in orthodontics. (Ex. 1003 ¶¶ 27-28.)

B. Background

Dentists have a long history of developing methods for moving teeth. In the early 1900's, "fixed appliances" were developed. Fixed appliances, also known as "braces," are so named because a wire, or archwire, is fixedly secured to the teeth in order to apply pressure and incrementally move the teeth. In the 1940's, "removable appliances" emerged as viable and popular alternatives as a result of advances made by H.D. Kesling and his "tooth positioners." (*See* Ex. 1006.) Kesling's positioners were elastomeric shell appliances made from plaster casts created by hand such that, when inserted, the positioner exhibited gentle pressure on the teeth, urging them into desired positions. As the teeth moved over time, new positioners were used to incrementally move the teeth into desired positions.

(*Id.*) While technology has revolutionized the field in terms of advances in materials used, planning, simulation, visualization and manufacture, the basic mechanics of tooth movement remains the same: a series of appliances, either fixed or removable, are used to incrementally move the teeth over time.

Dentistry, and in particular orthodontics, was quick to embrace computer technology. Early dentition modeling research led to developing a 3D predictive model that incorporated 2D diagnostic data into a computer program in order to simulate and predict orthodontic treatment planning. One of the earliest reports of using computer technology to model and manipulate digital images of teeth for the purposes of orthodontics was in 1970 by Biggerstaff. (Ex. 1007.) Although primitive by today's standards, simulating complex tooth movements such as translation and rotation were possible. Biggerstaff described providing computerized diagnostic setups and simulations, including the computerized realignment of teeth, individually or as a group, in multiple planes of space, with specified directions and magnitude. Other functions such as simulations of extractions and space closure were also included. Biggerstaff noted immediate clinical applications for his modeling tool and envisioned how computer technology would revolutionize the field over standard setup techniques. (*Id.*)

The next major advancement in the field of dentistry was the ability to digitize patients' cast study models, *i.e.*, for planning orthodontic treatment. In

1978, Faber described digitizing lateral head films and moving teeth along the curves of predetermined arch forms or determining available space. (Ex. 1008.) Around the same time in 1979, Burstone disclosed digitizing study models and step-by-step protocols for creating a "computerized wax setup." (Ex. 1009.) Burstone followed a structured process of creating a setup starting with: identifying a midline position and determining if posterior teeth needed to be moved to aid in its correction; establishing the midline position relative to a facial midline position; and changing an arch width to create a digital arch form in the shape of a parabola. (*Id.*) At the same time, a computer was used to calculate arch length inadequacy and positions of individual teeth, including where the cusps from the upper and lower teeth fit together. Control points, such as a midline point or width points, were used to provide further detail to the setup. Simulations of extraction treatments and changes in molar position could also be accommodated in this process. New arrangements were then "replotted" by the computer. (*Id.*) A key aspect of this report was avoiding common "stereotyped treatment" and instead using computer technology to create *custom orthodontic treatments for individuals based on their unique setups,* created under the guidance of an orthodontist. (*Id.,* 6.)

By the 1990s, digital set-ups of teeth were widely available. (*See, e.g.*, Ex. 1010.) The technologies underlying obtaining digital data sets and digital treatment planning became more widespread, and Align attempted to patent this subject matter in numerous iterations. (*See, e.g.*, patents listed on cover of the '444 patent, including 6,217,325; 6,471,511; 6,514,074; 6,729,876; 7,331,783; 7,377,778; 7;435;083.) Each of Align's patents discloses the same core subject matter: obtaining initial digital data sets and then using a computer to determine a treatment path, thereby creating intermediate and final digital data sets that can be used to display the treatment to a patient or to create appliances. Because Align's patents do no more than attempt to cover subject matter that was widely known and available, the '444 patent—directed to precisely the same subject matter—should never have been granted, and Align's own patents provide directly relevant prior art in evidence of this fact.

See also Ex. 1003 ¶¶ 29-62.

C. Overview of the '444 Patent

The '444 patent, entitled "Automated Treatment Staging for Teeth," is directed to a computer-implemented system and method for generating an orthodontic treatment. (Ex. 1001, Abstract.) The system provides an automated approach for staging movement of teeth from an initial position to a final, corrected position, and can minimize the treatment period while avoiding collisions. (*Id.*, 2:6-17.) (Ex. 1003 ¶¶ 63-67.)

In one embodiment, an initial digital data set is obtained by scanning an impression of the patients' teeth, a well-known process. (Ex. 1001, 5:11-19; *see, e.g.*, Ex. 1010.) A human operator and/or a computer program then manipulates the teeth into their final positions, and the program calculates the intermediate positions, *i.e.*, the steps of treatment. (Ex. 1001, 3:45-51.) Calculating intermediate positions takes into account various constraints and any collisions that might occur. (*Id.*, 3:51-61.)

As shown in Fig. 2B, the patent attempts to optimize tooth movement during treatment by selecting the most appropriate movement pattern:

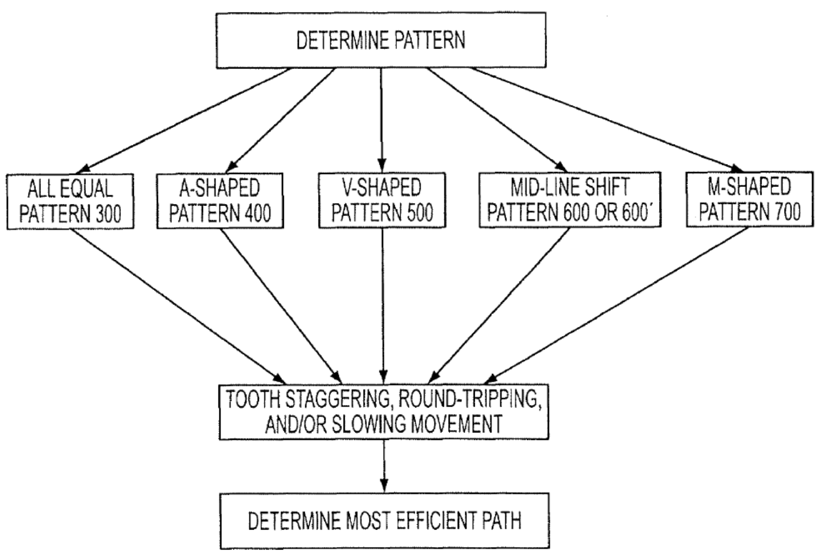

FIG. 2B

The independent claims focus on computer-implemented methods, systems, and machine-readable mediums that:

- Receive an initial digital data set of the teeth;

- Receive a final digital data set of the teeth; and
- Determine an order of movement that avoids collision or obstruction through at least one of staggering and round-tripping.

But, as will be shown below, each of these elements was well-known in the art, and disclosed in detail in Align's own patents.

In fact, the '444 patent admits that several steps were known in the art:

> U.S. patent application Ser. No. 09/169,276, now abandoned; Ser. Nos. 09/264,547; and 09/311,716, now U.S. Pat. No. 6,514,074 *describe techniques for generating 3-dimensional digital data sets containing models of individual components of a patient's dentition. These data sets include digital models of individual teeth* and the gingival tissue surrounding the teeth. Furthermore, these applications also describe computer-implemented techniques for using the digital models in designing and simulating an orthodontic treatment plan for the patient. For example, one such technique involves receiving an initial data set that represents the patient's teeth before treatment, specifying a desired arrangement of the patient's teeth after treatment, and calculating transformations that will move the teeth from the initial to the final positions over desired treatment paths. U.S. patent application Ser. No. 09/169,276 also describes the creation of data sets representing the tooth positions at various treatment stages and

> the use of these data sets to produce orthodontic appliances that implement the treatment plan.[1]

(*Id.*, 3:10-2, emphasis added.) Based on this recitation, Align explicitly admits that:

- Receiving an initial digital data set for individual teeth was known in the art;
- Using these models in designing an orthodontic treatment plan was known in the art; and
- Calculating positions moving teeth from initial positions to final positions was known in the art.

These admissions cover the elements of the independent claims, and are disclosed in numerous patents owned by Align, including Chishti '876 and Chishti '511, as detailed below.

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[1] Applications 09/264,547 and 09/311,716 both issued as patents prior to the earliest filing date of the '444 patent (U.S. Pat. Nos. 7,063,532 (June 20, 2006) and 6,514,074 (February 4, 2003), respectively). Application 09/169,276, though abandoned, was incorporated by reference into application 09/311,716, and therefore is also prior art to the '444 patent. (*See* MPEP § 2127(I).)

D. The Prosecution History of the '444 Patent

The '444 patent was originally filed on Aug. 30, 2007 with claims 1-42. (Ex. 1002, 994-1003.) After four years of inactivity, a first action Notice of Allowance was issued on June 6, 2011. (*Id.*, 884-890.)

Without referring to any specific reference, the Examiner indicated that the prior art fails to teach or suggest an apparatus or method which comprises steps or means for receiving, at a host computer "an electronic representation of each dental object of the plurality of dental objects in relation to one another, receiving by the host computer, an electronic representation a desired final position for each respective dental object; and determining, by the host computer, an order of movement for each respective dental object such that the dental objects avoid colliding with or obstructing each other on their respective routes from said initial position to said desired final position through at least one of staggering and roundtripping of at least one dental object." (*Id.*, 889.)

The Examiner's reason for allowance simply parrots the language of the independent claims, and belies belief in view of the prior art, particularly Align's own patents.

VI. CLAIM CONSTRUCTION

In an IPR, a claim in an unexpired patent is given its broadest reasonable construction in light of the specification. 37 C.F.R. § 42.100(b); Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012). In determining their scope, claim terms receive their ordinary and customary meaning as would be understood by a POSITA in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

This Petition applies the broadest reasonable interpretation standard for claim terms, although this may be, and often is, different from a claim construction in district court. *See, e.g.*, *In re Trans Texas Holdings Corp.*, 498 F.3d 1290, 1297 (Fed. Cir. 2007). Thus, the interpretations in this Petition, including where there is no express construction, do not necessarily reflect the claim constructions that Petitioner believes should be adopted by a district court under the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005).

In view of the above, claim interpretations submitted herein for the purpose of demonstrating a Reasonable Likelihood of Prevailing are neither binding upon litigants in any litigation, nor do such claim interpretations correspond to the construction of claims under the legal standards that are mandated to be used by the courts in litigation. The interpretation of the claims presented either implicitly or explicitly herein should not be viewed as constituting, in whole or in part, Petitioner's own interpretation and/or construction of such claims for the purposes of any future litigation. Constructions in this proceeding should be viewed only as interpretation under the "broadest reasonable construction" standard.

A. "Staging the movement of a plurality of dental objects"

"Staging the movement of a plurality of dental objects" includes moving teeth in an orthodontic treatment. (*See, e.g.*, Ex. 1001, abstract ("Apparatus, system, and methods for utilizing one or more computing devices to stage the movement of teeth during an alignment treatment"); 1:17-19 ("The present invention is related generally to the field of orthodontics, and more particularly to staging a path of movement for correcting the position of one or more teeth"); 2:6-8 ("Embodiments of the present invention provide apparatus, systems, and methods for automated staging of teeth, from an initial position to a final, corrected position").) The process is shown in Figure 11, referring to dental objects:

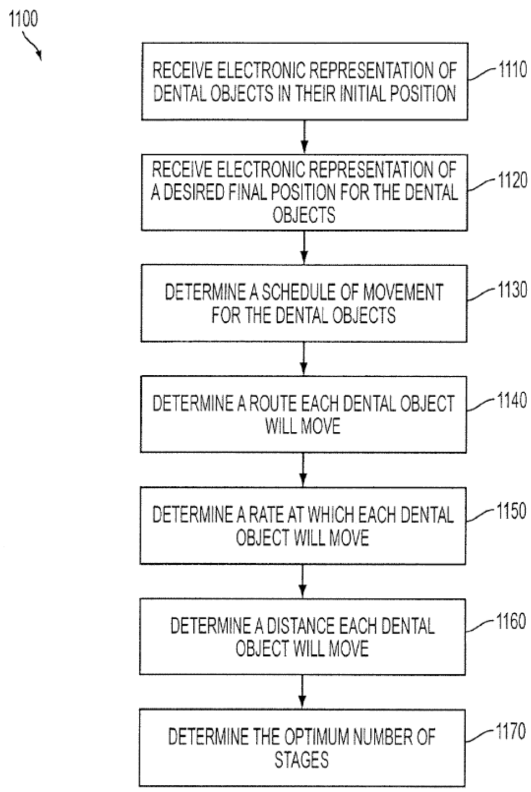

FIG. 11

Based on the recitations in the patent, a POSITA would understand dental objects to refer to teeth, and the staging movement would include planning movement in an orthodontic treatment. (Ex. 1003 ¶¶ 70-71.)

B. "Staggering"

"Staggering" is defined in the '444 patent as "the process of delaying one or more teeth from moving one or more stages where it would otherwise move in order to prevent another tooth from colliding with and/or obstructing the path of the delayed tooth." (Ex. 1001, 12:44-48.) This is an example of the patent owner acting as their own lexicographer, as an explicit definition is provided in the specification. *See, e.g.*, *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994.)

Even with this particular definition, staggering is a well-known technique that may be necessary in an orthodontic treatment. Accordingly, a POSITA would understand staggering to refer to delaying one or more teeth from moving one or more stages where it would otherwise move in order to prevent another tooth from colliding with and/or obstructing the path of the delayed tooth. (Ex. 1003 ¶¶ 72-73.)

C. "Round-tripping"

"Round-tripping" is defined in the '444 patent as "moving a first tooth out of the path of a second tooth, and once the second tooth has moved sufficiently, moving the first tooth back to its previous position before proceeding to a desired final position of that first tooth." (Ex. 1001, 12:51-55.) This again is an example of the patent owner acting as their own lexicographer, as an explicit definition is provided in the specification. *See, e.g.*, *Paulsen*, 30 F.3d at 1480. Even with this particular definition, round-tripping is a well-known technique that may be necessary in an orthodontic treatment. (Ex. 1003 ¶¶ 81-85.) Accordingly, a POSITA would understand round-tripping to refer to moving a first tooth out of the path of a second tooth, and once the second tooth has moved sufficiently, moving the first tooth back to its previous position before proceeding to a desired final position of that first tooth. (*Id.*, ¶¶ 74-75.)

D. "Through at least one of staggering and round-tripping of at least one dental object"

The independent claims specify that the order of movement avoids collisions or obstructions "through at least one of staggering and round-tripping of at least one dental object." This element is equivalent to a *Markush* group. Accordingly, disclosure of either staggering or round-tripping is sufficient to meet this element. *See Fresenius USA, Inc. v. Baxter Int'l, Inc.*, 582 F.3d 1288, 1298 (Fed. Cir. 2009) (citations omitted) ("the entire element is disclosed by the prior art if one alternative in the *Markush* group is in the prior art").

All other claim terms have been accorded their broadest reasonable interpretation in light of the patent specification including their plain and ordinary meaning to the extent such a meaning could be determined by a skilled artisan.

E. "means for"

Claims 15-28 of the '444 patent are all directed to a "system for staging the movement of a plurality of dental objects" including "means for" performing certain functions. In fact, claims 15-28 do not appear to include any non-"means" elements. These limitations invoke 35 U.S.C. § 112, ¶ 6, because they recite "means for" performing functions, and are not modified by sufficient structure, material, or acts for achieving the specified functions.

The '444 patent generally describes that a processor, computer program, computing device, configured program stored within a computing device, and/or computer algorithm are used to implement the alleged invention. (*See* Ex. 1001, 3:42-52, 4:42-5:28, 5:40-41, 6:17-20, 6:27-38, 7:12-14, 12:57-59.) However, the '444 patent specification fails to recite any specific structure or algorithms, linked to the claimed means, beyond a general purpose computer. *WMS Gaming Inc. v. Int'l Game Tech.*, 184 F.3d 1339 (Fed. Cir. 1999). Thus, Petitioner respectfully submits that claims 15-28 are indefinite under 35 U.S.C. § 112, ¶ 2.[2,3]

However, for the purposes of this Petition, Petitioner interprets the structure corresponding to all of the "means" in claims 15-28 to include any computer configuration that would perform the claimed functions.

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[2] Although rejections under 35 U.S.C. § 112 are not within the scope of this *inter partes* review, the PTAB may determine that further analysis into prior art grounds of unpatentability must fall because they would be based on a speculative meaning of the claims. *See BlackBerry Corp. v. MobileMedia Ideas, LLC*, Case IPR2013-00036, Paper No. 65 at 20 (March 7, 2014) (*citing In re Steele*, 305 F.2d 859, 862-63 (CCPA 1962)).

[3] *See Ergo Licensing, LLC v. CareFusion 303, Inc.*, 673 F.3d 1361, 1365 (Fed. Cir. 2012) ("[i]t is only in the rare circumstances where any general-purpose computer without any special programming can perform the function that an algorithm need not be disclosed") and MPEP § 2181(II)(B).

VII. GROUNDS OF UNPATENTABILITY SHOWING THAT PETITIONER HAS A REASONABLE LIKELIHOOD OF PREVAILING

A. Chishti ’876 Renders Claims 1-42 Unpatentable Under 35 U.S.C. § 103(a)[4]

Chishti ’876 discloses precisely the same subject matter as the ’444 patent. (*See generally* Ex. 1004.) In Chishti ’876, a physical model of an individual’s teeth is electronically scanned to create an initial digital data set, the initial digital data set is manipulated to obtain a final digital data set, and the computer generates treatment stages corresponding to intermediate digital data sets. (Ex. 1004, 2:15-35 (general summary); 7:65-8:8 (obtaining an initial digital data set by scanning a

[4] Ground 1 is based on a single reference, but is identified as a rejection under 35 U.S.C. § 103(a) out of an abundance of caution. As discussed in this section, Chishti ‘876 discloses an embodiment and teaches all features claimed by the ‘444 patent. However, while all the claimed features of the ‘444 patent are shown by Chishti ‘876, it might be argued that some features are optional, not necessarily required in every disclosed embodiment, or part of different embodiments (e.g., with respect to descriptions of features “[i]n some embodiments” or in “[o]ne implementation” of an algorithm, see Ex. 1004, 14:41-65). (*See Net MoneyIn, Inc. v. Verisign, Inc.*, 545 F.3d 1359, 1368-71 (Fed. Cir. 2008).) Nevertheless, Chishti ‘876 teaches all features claimed by the ‘444 patent, in combination.

model); 8:22-9:6 (manipulating the teeth into a final digital data set); 9:7-12 (defining intermediate steps corresponding to treatment stages); Fig. 3.)

In Chishti '876, the treatment plan is optimized by considering various constraints and avoiding collisions, just as in the '444 patent. (Ex. 1004, 3:60-4:30; Fig. 5.) And, the treatment plan can incorporate staggering and round-tripping. (Ex. 1004, 11:59-60 (considering which teeth need to be moved before others are moved, *i.e.*, staggering); 14:46-51 (discussing round-tripping).)

The features of Chishti '876 are illustrated in Figs. 3 and 5:

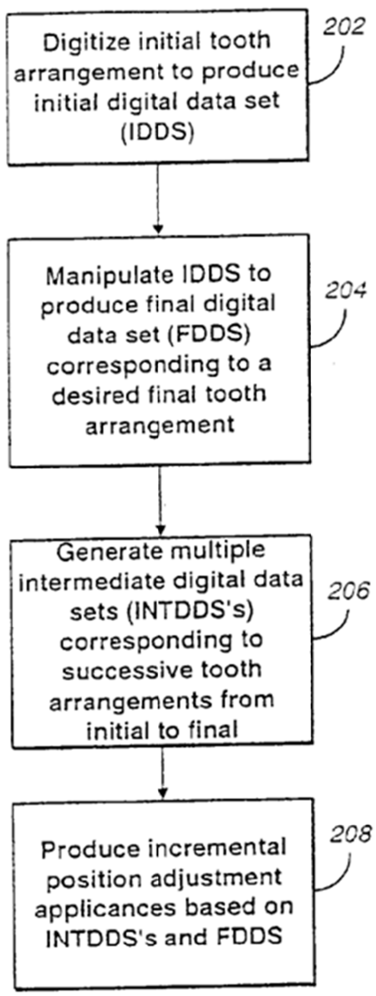


FIG._3

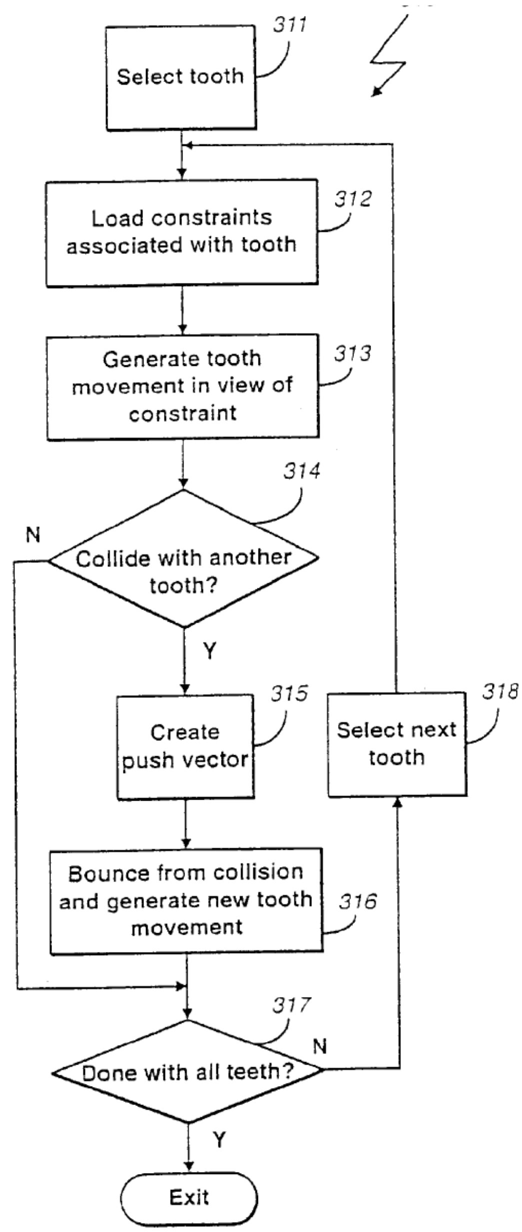
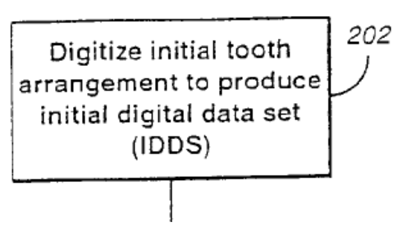


FIG._5

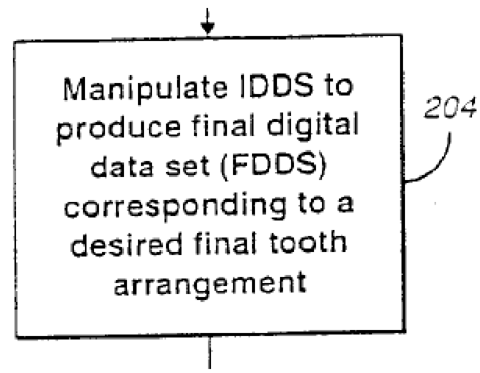
As detailed below, Chishti '876 teaches every element of the claims of the '444 patent.

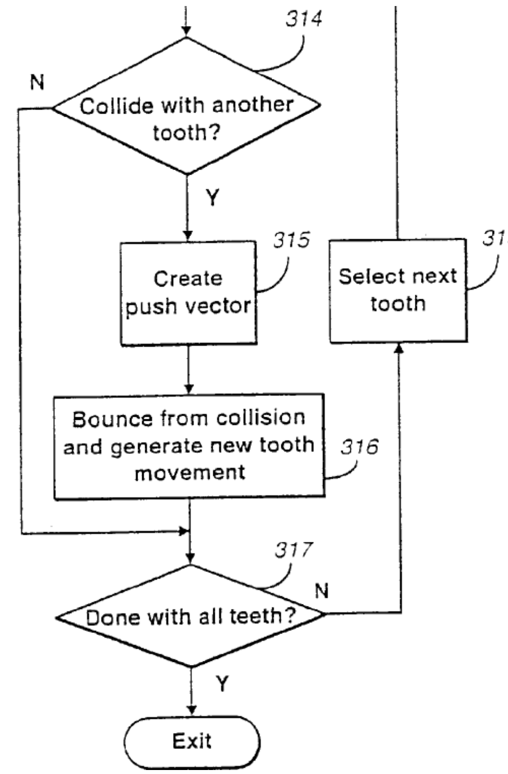
See also Ex. 1003 ¶¶ 76-78.

1. Identification of Where Each Element of Claims 1-42 is Found in Chishti ’876.

U.S. Patent No. 8,038,444	Chishti ’876
1. A computer-implemented method for staging the movement of a plurality of dental objects, the method comprising:	Chishti ’876 discloses a computer-implemented method for determining a treatment plan for a plurality of teeth, *i.e.*, dental objects. (*See, e.g.*, Ex. 1004, 2:15-20; 9:13-20 (necessary to define or map the movement of individual teeth); *see also* 23:7-15, describing implementation in computer hardware and/or software.)
receiving, at a host computer, an electronic representation of each dental object of the plurality of dental objects in relation to one another;	Chishti ’876 describes receiving an initial digital data set, *i.e.*, an electronic representation, by scanning a plaster cast of a patient’s teeth: As a first step, an initial digital data set (IDDS) representing an initial tooth arrangement is obtained (step 202). In some implementations, the IDDS includes data obtained by scanning a physical model of the patient’s teeth, such as by scanning a positive impression or a negative impression of the patient’s teeth with a laser scanner or a destructive scanner… (*See, e.g.*, Ex. 1004, 7:65-8:21.) This is the same process described in the ’444 patent. (Ex. 1001, 5:12-16.) And, this is the same process admitted by Align to be known in the art. (Ex. 1001, 3:10-37.) This excerpt from Fig. 3 is relevant: 

	Because the initial digital data set includes a model of the patient's teeth, each tooth in the model is represented in relation to each other tooth in the model. For example, Chishti '876 teaches that teeth or other components are originally modeled in relation to each other: Individual tooth and other components may be segmented or isolated in the model to permit their individual repositioning or removal from the digital model. (Ex. 1004; 8:22-25.)
receiving, by the host computer, an electronic representation of a desired final position for each respective dental object; and	Chishti '876 describes receiving a final digital data set ("FDDS"), *i.e.*, an electronic representation, at a host computer for each tooth through the user or the computer manipulating the digital models to achieve final tooth positions by using the computer (thus the computer receives the final digital data set): The FDDS is created by following the orthodontists' prescription to move the teeth in the model to their final positions. In one embodiment, the prescription is entered into a computer, which automatically computes the final positions of the teeth. In alternative other embodiments, a user moves the teeth into their final positions by independently manipulating one or more teeth while satisfying the constraints of the prescription. (*See, e.g.*, Ex. 1004, 8:50-59.) This is the same process described in the '444 patent. (Ex. 1001, 3:48-51.)

	This excerpt from Fig. 3 is relevant: 
determining, by the host computer, an order of movement for each respective dental object such that the dental objects avoid colliding with or obstructing each other on their respective routes from said initial position to said desired final position	Chishti '876 describes the host computer determining a treatment plan for each tooth that avoids collisions or obstructions on their respective routes from their initial position to their final position, using a collision detection algorithm: If any collisions are detected, the program alters the path of at least one tooth in each colliding pair by selecting a new position for one of the intermediate steps (step 1608) and creating a new spline curve (1602). The program then samples the new path (1604) and again applies the collision detection algorithm (1606). The program continues in this manner until no collisions are detected. (Ex. 1004, 13:38-45; *see also* 12:52-60 (detecting collisions or obstructions); Fig. 5.) Chishti '876 also explicitly teaches that the order of movement for each respective tooth is determined: [I]t is necessary to define or map the movement of selected individual teeth

	from the initial position to the final position over a series of successive steps. (Ex. 1004, 9:17-19.) See this excerpt from Fig. 5: 
through at least one of staggering and round-tripping of at least one dental object.	Treatment plans generated by Chishti '876 contemplate less-direct routes such as staggering: The algorithm then resorts to less direct routes to the final positions only if collisions will occur… (Ex. 1004; 14:55-58.) Considerations on when a tooth may be moved include…which teeth need to be moved before others are moved. (Ex. 1004; 11:43-60.) As would be understood by a POSITA, this is equivalent to staggering as discussed above, meaning determining movement patterns so that movement of particular teeth does not occur at the

	same time, and as explained in the '444 patent. (Ex. 1003 ¶¶ 72-73.) Thus, the Chishti '876 method avoids collisions or obstructions through at least one of staggering and round-tripping. This element is disclosed by Chishti '876 because it discloses one alternative—staggering—within the *Markush* group. *See* claim construction Section VI(D) above.
2. The computer-implemented method of claim 1, wherein determining the order of movement, comprises: (a) determining a route each respective dental object will move to achieve its respective final position;	The method of Chishti '876 necessarily determines the route each tooth will move to achieve its final position. > [I]t is necessary to define or map the movement of selected individual teeth from the initial position to the final position over a series of successive steps. (Ex. 1004, 9:17-19.) > [T]he software automatically computes the treatment path, based upon the IDDS and the FDDS. This is accomplished using a path scheduling algorithm which determines the rate at which each component, i.e., each tooth, moves along the path from the initial position to the final position. (Ex. 1004, 14:41-46.) And, Chishti '876 specifically states that the algorithm "resorts to *less direct routes* to the final positions only if collisions will occur…" (Ex. 1004; 14:55-57; *see also* 13:38-40 (program will alter route if collision detected).
(b) determining the distance each respective dental object will move to achieve its respective final position; and	Chishti '876 discloses determining the distance each respective dental object will move to achieve the final positions:

	For example, if only a final position is defined for a particular component, each subsequent stage after the initial stage will simply show the component an equal linear distance and rotation… closer to the final position. If the user specifies two key frames for that component, the component will "move" linearly from the initial position through different stages to the position defined by the first key frame. It will then move, possibly in a different direction, linearly to the position defined by the second key frame. Finally, it will move, possibly in yet a different direction, linearly to the target position. (Ex. 1004, 12:12-21.) The path-generating program, whether using linear or non-linear interpolation, selects the treatment positions so that the tooth's treatment path has approximately equal lengths between each adjacent pair of treatment steps. (Ex. 1004, 13:49-52.) Chishti '876 further discloses that the algorithm determines distances. (Ex. 1004; 5:35-36 ("Fig. 2B…defines how *tooth movement distances* are determined").)
(c) determining a rate at which each respective dental object will move along its respective route.	The method of Chishti '876 determines the rate of movement as the rate of movement is merely the distance moved in relation to the treatment stages. And, Chishti '876 discloses using a path scheduling algorithm that determines the rate: In some embodiments, as alluded to above, the software automatically computes the treatment path, based

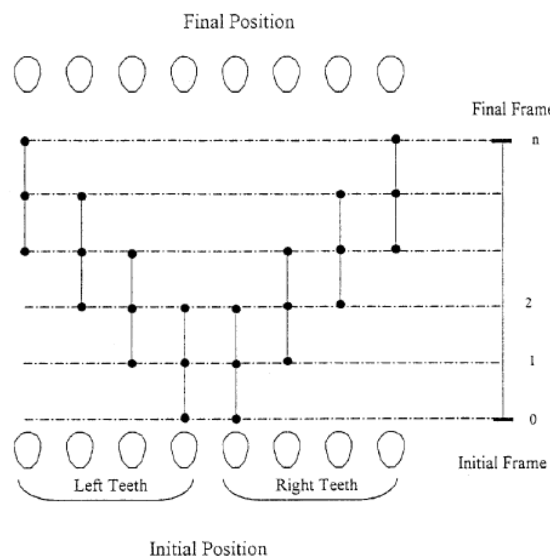
	upon the IDDS and the FDDS. This is accomplished using a path scheduling algorithm which determines the rate at which each component, i.e., each tooth, moves along the path from the initial position to the final position. (Ex. 1004, 14:41-46.) Chishti '876 also describes goals for rate of movement: [E]ach aligner should be able to accomplish move about 0.25-0.33 mm and to rotate about 5-10 degrees within a 2-week period. However, biologic variability, patient and clinician preferences are also taken into consideration. (Ex. 1004, 10:23-27.)
3. The computer-implemented method of claim 2, further comprising: determining (a), (b), and (c) in relation to each of the other dental objects.	The method of Chishti '876 determines route, distance of movement, and rate of movement in relation to each of the other teeth as discussed above with regard to claim 2. The method is initially conducted on a tooth by tooth basis, and then the movement patterns for the teeth are evaluated against each other in order to avoid obstructions or collisions: In generating the index reducing movements of step 310, the process considers a set of movement constraints which affect the tooth path movement plan…. Considerations on when a tooth may be moved include the following: … 7. Teeth moving past each other … 12. Which teeth move first?

	13. Which teeth need to be moved before others are moved? (Ex. 1004, 11:32-65.) The process of FIG. 5 then detects whether the planned movements would cause collisions with neighboring teeth (step 314)…. If a collision occurs, a "push" vector is created to shift the path of the planned movement (step 315). (Ex. 1004, 12:53-62; see also 12:44-13:10.)
4. The computer-implemented method of claim 3, wherein determining (a), (b), and (c) in relation to each of the other dental objects step comprises adjusting at least one of the route and the rate of at least one dental object to avoid collision with at least one other dental object.	The method of Chishti '876 determines route, distance of movement, and rate of movement in order to avoid collision with other teeth. Chishti '876 teaches adjusting at least one of the route and the rate of at least one dental object to avoid collision with at least one other dental object. For example: If a collision occurs, a "push" vector is created to shift the path of the planned movement (step 315). Based on the push vector, the current tooth "bounces" from the collision and a new tooth movement is generated (step 316). From step 314 65 or 316, the movement of the current tooth is finalized. (Ex. 1004, 12:61-65.) If any collisions are detected, the program alters the path of at least one tooth in each colliding pair by selecting a new position for one of the intermediate steps (step 1608) and

	creating a new spline curve (1602). The program then samples the new path (1604) and again applies the collision detection algorithm (1606). (Ex. 1004, 13:38-44.) (*See also* 12:44-13:10; Fig. 5.)
5. The computer-implemented method of claim 1, further comprising determining, by the host computer, an optimal number of stages for the order of movement of the dental objects.	The method of Chishti ’876 determines an optimal number of stages, suggesting that the number of stages should be chosen to keep the amount of movement in each stage at an optimal level: The method can include dividing a path for one or more teeth into the series of stages while keeping the movement of teeth in each stage below a predetermined range. (Ex. 1004, 2:32-35; *see also* 13:49-55.) The method of Chishti ‘876 includes a path scheduling algorithm that “schedule[s] or stage[s] the movements of the teeth.” (Ex. 1004, 14:52-55.) In one example, the optimal number of stages is determined to be around 50. (Ex. 1004, 11:34-36.) Further, it was well-known in the art to that optimizing the number of stages was a key aspect of determining a treatment plan. (Ex. 1003, ¶¶ 104-105.) Thus, a POSITA practicing Chishti ’876 would necessarily determine an optimal number of stages for the order of movement.
6. The computer-implemented method of claim 5, wherein determining the optimal number of stages step comprises: determining a total	When determining the optimal number of stages, the method of Chishti ’876 necessarily determines the total distance each tooth will move to achieve respective final position. (Ex. 1003 ¶¶ 90-93.) And, Chishti ’876 specifically states that the

distance each respective dental object will move;	algorithm determines distances. (Ex. 1004; 5:35-36 ("Fig. 2B…defines how *tooth movement distances* are determined").) Chishti '876 states that if only a final position is defined for a particular tooth, each stage will move an equal distance closer to the final position, which necessarily requires calculating a total distance of movement: For example, if only a final position is defined for a particular component, each subsequent stage after the initial stage will simply show the component an equal linear distance and rotation (specified by a quatemion) closer to the final position. If the user specifies two key frames for that component, the component will "move" linearly from the initial position through different stages to the position defined by the first key frame. It will then move, possibly in a different direction, linearly to the position defined by the second key frame. Finally, it will move, possibly in yet a different direction, linearly to the target position. (Ex. 1004, 12:12-21.) The path-generating program, whether using linear or non-linear interpolation, selects the treatment positions so that the tooth's treatment path has approximately equal lengths between each adjacent pair of treatment steps. (Ex. 1004, 13:49-52.)
dividing the total distance for each dental object by its respective maximum speed to	Chishti '876 describes dividing the total distance by linear or non-linear interpolation. (Ex. 1004; 12:6-43; *see also* 3:63-4:7 (discussing the amount

determine a number of movement stages for each dental object;	of movement that can occur in each stage). In a path-generating program, Chishti '876 further describes that dividing the total distance into "approximately equal lengths" takes into account the "maximum linear or rotational velocity at which a tooth should move, the maximum distance over which a tooth should move between treatment steps," and "avoids treatment positions that force portions of a tooth to move with more than a given maximum velocity" to establish safe limits for the patient. (Ex. 1004, 13:49-67.) To a POSITA, this clearly teaches dividing the total distance to determine a number of movement stages for each tooth. (Ex. 1003 ¶¶ 94-97.)
determining a number of non-movement stages for each respective dental object;	As is well-known to a POSITA, a treatment plan can include both movement and non-movement stages, and by generating the plan, a number (i.e., zero or more) non-movement stages are necessarily determined for use in the plan. (Ex. 1003 ¶¶ 98-100.) Chishti '876 explicitly describes non-movement stages: > [T]he orthodontist has precise control over which teeth the orthodontist wants to move and which teeth to anchor (not move), thereby breaking the treatment down into discrete stages. (Ex. 1004; 10:14-18; *see also* 11:66-12:5 (components may not be moved in a particular treatment stage); see also 17:1-3 (in A-type movement, anterior tooth moves first, followed by posterior tooth, so some teeth have non-movement stages, as would be the same for V-type movement).)
adding the number of	Chishti '876 teaches using an array tracking

movement stages to the number of non-movement stages for each dental object to determine a minimum number of stages for each respective dental object; and	movements for each tooth over time. (Ex. 1004; 11:32-43.) A POSITA would have used such an array to add the number of movement and non-movement stages, determining a minimum number of stages for each tooth. (Ex. 1003 ¶¶ 102-104.) *See also* Figs.10-13 in Chishti '876, illustrating exemplary movement patterns, which include movement and non-movement stages for each tooth. Fig. 11:  FIG. 11
selecting the largest of the minimum number of stages.	Chishti '876 teaches "creating each treatment path to require only the minimum amount of movement" to reach the tooth movement goal (Ex. 1004, 3:63-4:7), and thus necessarily teaches selecting the largest of the minimum number of stages, as this is the minimum amount of movement possible for all teeth to reach their final goal. (Ex. 1003 ¶¶ 104-105.) Moreover, it would have been an obvious variation for a POSITA to select the largest of the minimum number of stages, because it is common sense for a practitioner that it is necessary to accommodate all teeth, and most desirable to

	accomplish the movement in the fewest number of stages possible. (Ex. 1003 ¶105.)
7. The computer-implemented method of claim 1, wherein the determining the order of movement, comprises, ordering the movement of the dental objects to form an all-equal pattern.	Chishti '876 discloses ordering movement in an "all-equal movement" pattern. (Ex. 1004; 2:45; 49-51; Fig. 15.)
8. The computer-implemented method of claim 1, wherein the determining the order of movement step comprises ordering the movement of the dental objects to form a V-shaped pattern.	Chishti '876 discloses ordering movement in a "V-shaped movement" pattern. (Ex. 1004; 2:46; 60-62; Fig. 12.)
9. The computer-implemented method of claim 1, wherein the determining the order of movement comprises: ordering the movement of the dental objects to form an A-shaped pattern.	Chishti '876 discloses ordering movement in an "A-shaped movement" pattern. (Ex. 1004; 2:46; 57-59; Fig. 11.)
10. The computer-implemented method of claim 1, wherein determining the order of movement step comprises ordering the movement of the dental objects to form an M-shaped pattern.	Chishti '876 discloses ordering movement in an "M-shaped movement" pattern. (Ex. 1004; 2:47.)
11. The computer-implemented method of claim 1, wherein, determining the order of movement step comprises ordering the movement of the dental objects to form a mid-line shift pattern.	As would be understood by a POSITA, implementing the method of Chishti '876 would necessarily move the teeth in a mid-line shift pattern in some circumstances. Chishti '876 is not limited in the types of occlusions treatable with this method, and specifically notes that midlines should be considered when evaluating final position goals. (Ex. 1004, 9:63.) Thus, a midline shift (as recited in the '444 patent) is contemplated and a POSITA practicing Chishti

	’876 would have used a mid-line shift pattern in some circumstances. (Ex. 1003 ¶¶ 86-89.)
12. The computer-implemented method of claim 1, wherein, determining the order of movement step comprises staggering the movement of at least two dental objects.	As discussed with regard to claim 1, Chishti ’876 states “Considerations on when a tooth may be moved include…which teeth need to be moved before others are moved.” (Ex. 1004; 11:43-60.) As would be understood by a POSITA, this is equivalent to staggering as discussed above, meaning determining movement patterns so that movement of particular teeth does not occur at the same time due to situations barring movement of the delayed tooth. (Ex. 1003 ¶¶ 72-73.)
13. The computer-implemented method of claim 1, wherein determining the order of movement step comprises, round tripping at least one dental object.	Chishti ’876 discusses round-tripping. (Ex. 1004; 14:46-51.) Although Chishti ‘876 describes “round-tripping” differently than the ‘444 patent, (compare Ex. 1004, 14:48-50, with Ex. 1001, 12:51-55), a POSITA would understand that, as used in the field of orthodontics, round-tripping is a broad concept related to moving one tooth more than required, and moving it back again, in order to accommodate the movement of a second tooth. It would have been obvious to a POSITA to use any known form of round-tripping in patient-specific situations requiring such movement of teeth, as necessary. (Ex. 1003 ¶¶ 81-85.)
14. The computer-implemented method of claim 1, wherein determining the order of movement step comprises, slowing the movement of at least one dental object.	Chishti ’876 discloses slowing the movement of at least one tooth, and thus teaches determining an order of movement that includes slowing the movement of at least one tooth. (Ex. 1004; 12:23-32.) One component may accelerate along a curve between one pair of stages…, while another moves linearly between another pair of stages (e.g., stages 1 to 5), and then changes direction suddenly and slows down along a linear path to a later stage (e.g., stage 10). (Ex. 1004, 12:25-31.)

15. A system for staging the movement of a plurality of dental objects, the system comprising: means for receiving an electronic representation of each dental object of the plurality of dental objects in relation to one another; means for receiving an electronic representation of a desired final position for each respective dental object; and means for determining an order of movement for each respective dental object such that the dental objects avoid colliding with each other on their respective routes from said initial position to said desired final position.	*See* claim construction of the "means for" in Section VI(E) above. *See* discussion above for claim 1. Chishti '876 describes a computer configured to perform these steps. (Ex. 1004, 1:17-19, 2:15-5:26, 23:7-32.)
16. The system of claim 15, wherein the means for determining the order of movement comprises: (a) means for determining a route each respective dental object will move to achieve its respective final position; (b) means for determining the distance each respective dental object will move to achieve its respective final position; and (c) means for determining a rate at which each respective dental object will move along its respective route.	*See* discussion above for claim 2.
17. The system of claim 16, further comprising means for determining (a), (b), and (c) in	*See* discussion above for claim 3.

relation to each of the other dental objects.	
18. The system of claim 17, wherein the means for determining (a), (b), and (c) in relation to each of the other dental objects comprises means for adjusting at least one of the route and the rate of at least one dental object to avoid collision with at least one other dental object.	*See* discussion above for claim 4.
19. The system of claim 15, further comprising means for determining an optimal number of stages for the order of movement of the dental objects.	*See* discussion above for claim 5.
20. The system of claim 19, wherein the means for determining the optimal number of stages step comprises: means for determining a total distance each respective dental object will move; means for dividing the total distance for each dental object by its respective maximum speed to determine a number of movement stages for each dental object; means for determining a number of non-movement stages for each respective dental object; means for adding the number of movement stages to the number of non-movement stages for each dental object to	*See* discussion above for claim 6.

determine a minimum number of stages for each respective dental object; and means for selecting the largest of the minimum number of stages.	
21. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects in an all-equal pattern.	*See* discussion above for claim 7.
22. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects in a V-shaped pattern.	*See* discussion above for claim 8.
23. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects in an A-shaped pattern.	*See* discussion above for claim 9.
24. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects to form an M-shaped pattern.	*See* discussion above for claim 10.
25. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects in a mid-line	*See* discussion above for claim 11.

shift pattern.	
26. The system of claim 15, wherein the means for determining the order of movement comprises means for staggering the movement of at least two dental objects.	*See* discussion above for claim 12.
27. The system of claim 15, wherein the means for determining the order of movement comprises means for round tripping at least one dental object.	*See* discussion above for claim 13.
28. The system of claim 15, wherein the means for determining the order of movement comprises means for slowing the movement of at least one dental object.	*See* discussion above for claim 14.
29. A machine-readable medium having stored thereon a plurality of instructions for staging the movement of a plurality of dental objects, the plurality of instructions when executed by a processor, causing the processor to: receive an electronic representation of each dental object in relation to one another in an initial position; receive an electronic representation of a desired final position for each respective dental object; and determine an order of movement for each respective dental object such that the dental objects avoid colliding with each other on their	*See* discussion above for claim 1. Chishti '876 describes a computer-implemented system for carrying out each of these steps. (Ex. 1004, 23:7-32.)

respective routes from said initial position to said desired final position.	
30. The machine-readable medium of claim 29, wherein the instructions causing the processor to determine the order of movement instructions further comprise instructions to: (a) determine a route each respective dental object will move to achieve its respective final position; (b) determine the distance each respective dental object will move to achieve its respective final position; and (c) determine a rate at which each respective dental object will move along its respective route.	*See* discussion above for claim 2.
31. The machine-readable medium of claim 30, further comprising instructions to: determine (a), (b), and (c) in relation to each of the other dental objects.	*See* discussion above for claim 3.
32. The machine-readable medium of claim 31, wherein the instructions to determine (a), (b), and (c) in relation to each of the other dental objects comprises instructions to adjust at least one of the route and the rate of at least one dental object to avoid collision with at least one other dental object.	*See* discussion above for claim 4.
33. The machine-readable medium of claim 29, further	*See* discussion above for claim 5.

comprising instructions to determine an optimal number of stages for the order of movement of the dental objects.	
34. The machine-readable medium of claim 33, wherein the instructions to determine the optimal number of stages comprise instructions to: determine a total distance each respective dental object will move; divide the total distance for each dental object by its respective maximum speed to determine a number of movement stages for each dental object; determine a number of non-movement stages for each respective dental object; add the number of movement stages to the number of non-movement stages for each dental object to determine a minimum number of stages for each respective dental object; and select the largest of the minimum number of stages.	*See* discussion above for claim 6.
35. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to order the movement of the dental objects to form an all-equal pattern.	*See* discussion above for claim 7.
36. The machine-readable	*See* discussion above for claim 8.

medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to order the movement of the dental objects to form a V-shaped pattern.	
37. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement, comprise instructions to order the movement of the dental objects to form an A-shaped pattern.	*See* discussion above for claim 9.
38. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to order the movement of the dental objects to form an M-shaped pattern.	*See* discussion above for claim 10.
39. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to order the movement of the dental objects a mid-line shift pattern.	*See* discussion above for claim 11.
40. The machine-readable medium of claim 29, wherein the instructions to determining the order of movement, comprise instructions to stagger the movement of at least two dental objects.	*See* discussion above for claim 12.
41. The machine-readable medium of claim 29, wherein the instructions to determine	*See* discussion above for claim 13.

the order of movement comprise instructions to round-trip at least one dental object.	
42. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to slow the movement of at least one dental object.	*See* discussion above for claim 14.

B. Chishti '511 in view of Chishti '876 Renders Claims 1-42 Unpatentable Under 35 U.S.C. § 103(a)

Chishti '511 discloses precisely the same subject matter as the '444 patent. (*See generally* Ex. 1005.) In Chishti '511, a physical model of an individual's teeth is electronically scanned to create an initial digital data set, the initial digital data set is manipulated to obtain a final digital data set, and the computer segments the path into treatment stages corresponding to intermediate digital data sets that correspond to appliances. (Ex. 1005, 1:33-58 (general summary); 3:39-49 (obtaining an initial digital data set by scanning a model); 3:59-4:6 (manipulating the teeth into a final digital data set); 4:7-22 (defining segments corresponding to treatment stages); Fig. 1.) The process of Chishti '511 is shown in Fig. 1:

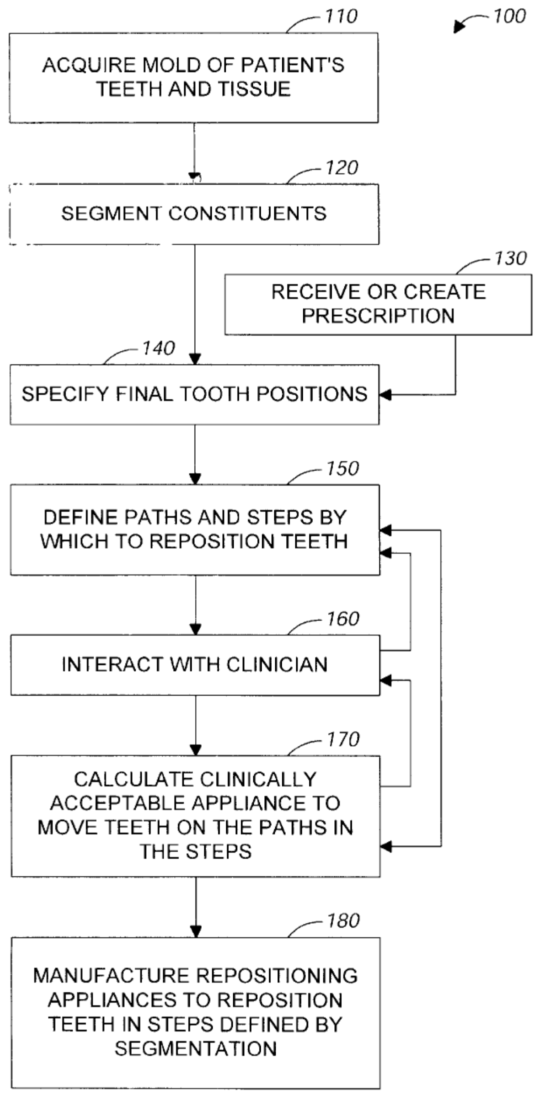


FIG. 1

The treatment plan is optimized by considering various constraints and avoiding collisions, just as in the ’444 patent. (Ex. 1005, 4:7-50.) And, the treatment plan can incorporate round-tripping. (Ex. 1005, 4:8-15 (discussing round-tripping).)

Although staggering is a well-known orthodontic technique that was known be necessary in complex treatment situations (Ex. 1003 ¶ 73), Chishti ’511 does not explicitly describe staggering. But, staggering in an orthodontic treatment plan is sometimes necessary, as would be recognized by a POSITA, and as explicitly taught in Chishti '876. Chishti '876 states "Considerations on when a tooth may be moved include…which teeth need to be moved before others are moved." (Ex. 1004; 11:43-60.) As would be understood by a POSITA, this is equivalent to staggering as discussed above, meaning determining movement patterns so that movement of particular teeth does not occur at the same time, and as explained in the '444 patent. Thus, the Chishti '876 method avoids collisions or obstructions through staggering. Accordingly, a POSITA implementing the system of Chishti '511 in view of Chishti '876 would use staggering if necessary in any patient's orthodontic treatment, precisely as taught by the '444 patent. (Ex. 1003 ¶¶ 72-73.)

Taken together, Chishti '511 and Chishti '876 teach every element of the claims of the '444 patent. A POSITA would have been motivated to generate treatment segments as taught by Chishti '511 and to use a staggering option or the other particular treatment paths as necessary as taught by Chishti '876 because these treatment options may be useful and even necessary in some treatment plans, depending on each individual patient's set of teeth. (Ex. 1003 ¶¶ 73, 86-89.) Both references are from the field of 3D imaging in dentistry, and are directed to identical systems that use digital data from a patient's teeth for treatment purposes. (Compare Ex. 1004, Fig. 3 and 1:17-19, with Ex. 1005, Fig. 1 and 1:24-30.)

Because the systems are identical and make use of the same initial digital data sets, intermediate digital data sets, and final data sets, combining the teachings of these references would be routine for a POSITA and would lead to predictable results with a reasonable expectation of success. (Ex. 1003, ¶ 80.)

1. Identification of Where Each Element of Claims 1-42 is Found in Chishti ’511 in view of Chishti ’876.

U.S. Patent No. 8,038,444	Chishti ’511 in view of Chishti ’876
1. A computer-implemented method for staging the movement of a plurality of dental objects, the method comprising:	Chishti ’511 discloses a computer-implemented method for determining a treatment plan for a plurality of teeth, *i.e.*, dental objects. (*See, e.g.*, Ex. 1005, 4:7-10 (process defines a tooth path for each tooth); *see also* 10:19-51, describing implementation in computer hardware and/or software.)
receiving, at a host computer, an electronic representation of each dental object of the plurality of dental objects in relation to one another;	Chishti ’511 describes receiving an initial digital data set, *i.e.*, an electronic representation, at a host computer by, *inter alia*, scanning a plaster cast of a patient’s teeth: As an initial step, a mold or a scan of patient’s teeth or mouth tissue is acquired (110). This step generally involves taking casts of the patient’s teeth and gums, and may also involve taking wax bites, direct contact scanning, x-ray imaging, tomographic imaging, sonographic imaging, and other techniques for obtaining information about the position and structure of the teeth, jaws, gums and other orthodontically relevant tissue. From the data so obtained, a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient’s teeth and other tissues.

	(Ex. 1005, 3:40-50; *see also* 50-58.) This is the same process described in the '444 patent. (Ex. 1001, 5:12-16.) And, this is the same process admitted by Align to be known in the art. (Ex. 1001, 3:10-37.) Chishti '511 teaches that the initial digital data set is "processed" (step 120) at a computer after being "acquired" (step 110), and thus are received at a host computer. (Ex. 1005, 3:51-54, 10:19-35.)
receiving, by the host computer, an electronic representation of a desired final position for each respective dental object; and	Chishti '511 describes receiving a final digital data set, *i.e.*, an electronic representation, at a host computer for each tooth from a clinician in the form of a prescription or calculated computationally. The desired final position of the teeth—that is, the desired and intended end result of orthodontic treatment—can be received from a clinician in the form of a prescription, can be calculated from basic orthodontic principles, or can be extrapolated computationally from a clinical prescription (step 130). With a specification of the desired final positions of the teeth and a digital representation of the teeth themselves, the final position and surface geometry of each tooth can be specified (step 140) to form a complete model of the teeth at the desired end of treatment. Generally, in this step, the position of every tooth is specified. The result of this step is a set of digital data structures that represents an orthodontically correct repositioning of the modeled teeth relative to presumed-stable tissue. The teeth and tissue are

	both represented as digital data. (Ex. 1005, 3:59-4:6.) This is the same process described in the '444 patent. (Ex. 1001, 3:48-51.)
determining, by the host computer, an order of movement for each respective dental object such that the dental objects avoid colliding with or obstructing each other on their respective routes from said initial position to said desired final position	Chishti '511 describes the host computer determining a treatment plan for each tooth that avoids collisions on their respective routes from their initial position to their final position: Having both a beginning position and a final position for each tooth, the process next defines a tooth path for the motion of each tooth. The tooth paths are optimized in the aggregate so that the teeth are moved in the quickest fashion with the least amount of round-tripping to bring the teeth from their initial positions to their desired final positions.… The tooth paths are segmented. The segments are calculated so that each tooth's motion within a segment stays within threshold limits of linear and rotational translation. In this way, the end points of each path segment can constitute a clinically viable repositioning, and the aggregate of segment end points constitute a clinically viable sequence of tooth positions, so that moving from one point to the next in the sequence does not result in a collision of teeth. (Ex. 1005, 4:7-22.)
through at least one of staggering and round-tripping of at least one dental object.	Chishti '511 describes treatment plans including round-tripping. (Ex. 1005, 4:7-16.) The tooth paths are optimized in the aggregate so that the teeth are moved in the quickest fashion with the least amount of round-tripping to bring the

	teeth from their initial positions to their desired final positions. (Ex. 1005, 4:9-12.) Although Chishti ‘511 describes “round-tripping” differently than the ‘444 patent (compare Ex. 1005, 4:13-16, with Ex. 1001, 12:51-55), a POSITA would understand that, as used in the field of orthodontics, round-tripping is a broad concept related to moving one tooth more than required, and moving it back again, in order to accommodate the movement of a second tooth. It would have been obvious to a POSITA to use any known form of round-tripping in patient-specific situations requiring such movement of teeth, as necessary. (Ex. 1003 ¶¶ 81-85.) This element is disclosed by Chishti ’511 because it discloses one alternative—round-tripping—within the *Markush* group. *See* claim construction Section VI(D) above. If this element is *not* considered to be equivalent to a *Markush* group, it would have been obvious to a POSITA that a treatment plan could involve staggering, based on Chishti ’876. As discussed with respect to claim 1 in Ground 1 above, Chishti ’876 teaches determining an order of movement for dental objects, including the staggering of at least one dental object in order to avoid collisions. (Ex. 1004, 14:55-58, 11:43-60.) Thus, Chishti ’511 in view of Chishti ’876 teaches determining an order of movement, for the benefit of avoiding collisions or obstructions, through at least one of staggering and round-tripping of at least one dental object. (Ex. 1003 ¶¶ 72-73.)

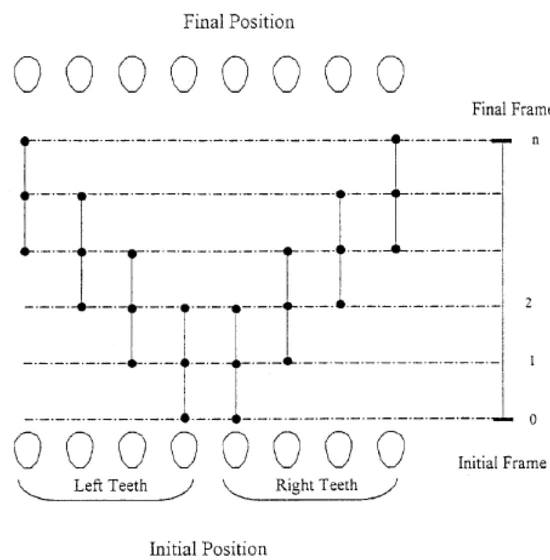
2. The computer-implemented method of claim 1, wherein determining the order of movement, comprises: (a) determining a route each respective dental object will move to achieve its respective final position;	The method of Chishti '511 necessarily determines the route each tooth will move to achieve its final position, and the "tooth path" is a route: Having both a beginning position and a final position for each tooth, the process next defines a tooth path for the motion of each tooth. The tooth paths are optimized in the aggregate so that the teeth are moved in the quickest fashion with the least amount of round-tripping to bring the teeth from their initial positions to their desired final positions. (Ex. 1005, 4:7-12.)
(b) determining the distance each respective dental object will move to achieve its respective final position; and	The method of Chishti '511 necessarily determines the distance each tooth will move to achieve its respective final position. Chishti '511 specifically states that the program segments the tooth paths so that each segment stays within threshold limits of motion, and this calculation requires determining the distance each tooth will move to reach the final position: The tooth paths are segmented. The segments are calculated so that each tooth's motion within a segment stays within threshold limits of linear and rotational translation. In this way, the end points of each path segment can constitute a clinically viable repositioning, and the aggregate of segment end points constitute a clinically viable sequence of tooth positions, so that moving from one point to the next in the sequence does not result in a collision of teeth.

	(Ex. 1005; 4:15-22.)
(c) determining a rate at which each respective dental object will move along its respective route.	The method of Chishti '511 determines the rate of movement, as the rate of movement is directly a relation between the distance to be moved and the number of stages to be moved by each tooth. Chishti '511 also describes goals for rate of movement that are taken into account, and explains that the algorithm can determine the rate of movement and evaluate it against clinical constraints: The methods include … computing the actual effect of the appliances on the teeth by analyzing the finite elements models computationally; and evaluating the effect against clinical constraints. The clinical constraints can include a maximum rate of displacement of a tooth, a maximum force on a tooth, and a desired end position of a tooth…. The maximum rate of displacement can be a linear or a[n] angular rate of displacement. (Ex. 1005, 2:4-34.)
3. The computer-implemented method of claim 2, further comprising: determining (a), (b), and (c) in relation to each of the other dental objects.	The method of Chishti '511 determines route, distance of movement, and rate of movement in relation to each of the other teeth. The method is initially conducted on a tooth by tooth basis, and then the movement patterns for the teeth are evaluated against each other in order to avoid obstructions or collisions. (*See, e.g.*, Ex. 1005, 4:7-12 ("tooth paths are optimized in the aggregate"))
4. The computer-implemented method of claim 3, wherein determining (a), (b), and (c) in relation to each of the other dental objects step comprises	The method of Chishti '511 determines route, distance of movement, and rate of movement in order to avoid collision with other teeth. (*See, e.g.*, Ex. 1005, 4:7-22 (each tooth path optimized in the aggregate to avoid collision).)

adjusting at least one of the route and the rate of at least one dental object to avoid collision with at least one other dental object.	[T]he aggregate of segment end points constitute a clinically viable sequence of tooth positions, so that moving from one point to the next in the sequence does not result in a collision of teeth. (Ex. 1005, 4:19-22.)
5. The computer-implemented method of claim 1, further comprising determining, by the host computer, an optimal number of stages for the order of movement of the dental objects.	The method of Chishti '511 determines an optimal number of stages, and it was well-known in the art to that optimizing the number of stages was a key aspect of determining a treatment plan. (*See, e.g.*, Ex. 1005, 4:7-12 (optimizing tooth paths (and thus number of stages) to move the teeth in quickest fashion.) The tooth paths are optimized in the aggregate so that the teeth are moved in the quickest fashion with the least amount of round-tripping…. (Ex. 1005, 4:9-11.) Chishti '511 also describes determining the number of stages so each stage involves an optimal amount of force: The segmented tooth paths and associated tooth position data are used to calculate clinically acceptable appliance configurations (or successive changes in appliance configuration) that will move the teeth on the defined treatment path in the steps specified by the path segments (step 170). Each appliance configuration represents a step along the treatment path for the patient. The steps are defined and calculated so that each discrete position can follow by straight-line

	tooth movement or simple rotation from the tooth positions achieved by the preceding discrete step and so that the amount of repositioning required at each step involves an orthodontically optimal amount of force on the patient's dentition. (Ex. 1005, 4:51-67.)
6. The computer-implemented method of claim 5, wherein determining the optimal number of stages step comprises: determining a total distance each respective dental object will move;	When determining the optimal number of stages, the method of Chishti '511 necessarily determines the total distance each tooth will move to achieve respective final position. (Ex. 1003 ¶¶ 90-93.) And, Chishti '511 specifically states that the program segments the tooth paths so that each segment stays within threshold limits of motion, and this calculation requires determining the aggregate distance each tooth will move to reach the final position: The tooth paths are segmented. The segments are calculated so that each tooth's motion within a segment stays within threshold limits of linear and rotational translation. In this way, the end points of each path segment can constitute a clinically viable repositioning, and the aggregate of segment end points constitute a clinically viable sequence of tooth positions, so that moving from one point to the next in the sequence does not result in a collision of teeth. (Ex. 1005; 4:15-22.)
dividing the total distance for each dental object by its respective maximum speed to determine a number of movement stages for each	Chishti '511 describes segmenting the tooth paths while keeping in mind the "maximum linear and angular velocity of each tooth" and the "maximum allowable displacement velocity for each tooth." (Ex. 1005, 6:38-55, 4:15-22.)

dental object;	To a POSITA, this clearly teaches dividing the total distance by its maximum speed to determine a number of movement stages for each tooth. (Ex. 1003 ¶¶ 94-97.)
determining a number of non-movement stages for each respective dental object;	As is well-known to a POSITA, a treatment plan can include both movement and non-movement stages, and by generating the plan, a number (i.e., zero or more) non-movement stages are necessarily determined for use in the plan.. (Ex. 1003 ¶¶ 98-100.) Although Chishti '511 does not explicitly describe non-movement stages, this is taught in Chishti '876: [T]he orthodontist has precise control over which teeth the orthodontist wants to move and which teeth to anchor (not move), thereby breaking the treatment down into discrete stages. (Ex. 1004; 10:14-18; *see also* 11:66-12:5 (components may not be moved in a particular treatment stage); *see also* 17:1-3 (in A-type movement, anterior tooth moves first, followed by posterior tooth, so some teeth have non-movement stages, as would be the same for V-type movement); Ex. 1003 ¶¶ 73, 86-89.) Accordingly, a POSITA implementing Chishti '511 in view of Chishti '876 would determine a number of non-movement stages for each tooth.
adding the number of movement stages to the number of non-movement stages for each dental object to determine a minimum number of stages for each respective dental object; and	Although Chishti '511 does not explicitly describe adding the number of movement stages to the number of non-movement stages for each dental object to determine a minimum number of stages for each respective dental object, this is taught in Chishti '876.

	Chishti ’876 teaches using an array tracking movements for each tooth over time. (Ex. 1004; 11:32-43.) A POSITA would have used such an array to add the number of movement and non-movement stages, determining a minimum number of stages for each tooth. (Ex. 1003 ¶¶ 102-104.) *See also* Figs.10-13 in Chishti ’876, illustrating exemplary movement patterns, which include movement and non-movement stages for each tooth. Fig. 11:  FIG. 11
selecting the largest of the minimum number of stages.	Although Chishti ’511 does not explicitly describe selecting the largest of the minimum number of stages, this is obvious in view of Chishti ‘511 and Chishti ’876. Chishti ‘511 describes that “tooth paths are optimized in the aggregate so that the teeth are moved in the quickest fashion with the least amount of round-tripping.” (Ex. 1005, 4:7-22.) Similarly, Chishti ’876 teaches “creating each treatment path to require only the minimum amount of movement” to reach the tooth

	movement goal. (Ex. 1004, 3:64-4:7.) Chishti ‘876 and Chishti ‘511 necessarily teach selecting the largest of the minimum number of stages, as this is the minimum amount of movement possible for all teeth to reach their final goal. (Ex. 1003 ¶¶ 104-105.) Moreover, it would have been an obvious variation for a POSITA to select the largest of the minimum number of stages, because it is common sense for a practitioner that it is necessary to accommodate all teeth, and most desirable to accomplish the movement in the fewest number of stages possible. (Ex. 1003 ¶105.)
7. The computer-implemented method of claim 1, wherein the determining the order of movement, comprises, ordering the movement of the dental objects to form an all-equal pattern.	Chishti ’511 does not detail particular movement patterns, but Chishti ’876 discloses ordering movement in an “all-equal movement” pattern. (Ex. 1004; 2:45; 49-51; Fig. 15.) It would have been obvious to implement an all-equal pattern in Chishti ‘511 where a patient’s teeth and specific orthodontic treatment would require it. (Ex. 1003 ¶¶ 86-89.)
8. The computer-implemented method of claim 1, wherein the determining the order of movement step comprises ordering the movement of the dental objects to form a V-shaped pattern.	Chishti ’511 does not detail particular movement patterns, but Chishti ’876 discloses ordering movement in a “V-shaped movement” pattern. (Ex. 1004; 2:46; 60-62; Fig. 12.) It would have been obvious to implement this pattern in Chishti ‘511 where a patient’s teeth and specific orthodontic treatment would require it. (Ex. 1003 ¶¶ 86-89.)
9. The computer-implemented method of claim 1, wherein the determining the order of movement comprises: ordering the movement of the dental objects to form an A-shaped pattern.	Chishti ’511 does not detail particular movement patterns, but Chishti ’876 discloses ordering movement in an “A-shaped movement” pattern. (Ex. 1004; 2:46; 57-59; Fig. 11.) It would have been obvious to implement this pattern in Chishti ‘511 where a patient’s teeth and specific orthodontic treatment would require it. (Ex. 1003 ¶¶ 86-89.)
10. The computer-implemented	Chishti ’511 does not detail particular movement

method of claim 1, wherein determining the order of movement step comprises ordering the movement of the dental objects to form an M-shaped pattern.	patterns, but Chishti ’876 discloses ordering movement in an “M-shaped movement” pattern. (Ex. 1004; 2:47.) It would have been obvious to implement this pattern in Chishti ‘511 where a patient’s teeth and specific orthodontic treatment would require it. (Ex. 1003 ¶¶ 86-89.)
11. The computer-implemented method of claim 1, wherein, determining the order of movement step comprises ordering the movement of the dental objects to form a mid-line shift pattern.	Chishti ’511 does not detail particular movement patterns, but it would have been obvious to a POSITA that implementing the method of Chishti ’876 would move the teeth in a mid-line shift pattern in some circumstances. Chishti ’876 is not limited in the types of occlusions treatable with this method, and specifically notes that midlines should be considered when evaluating final position goals. (Ex. 1004, 9:63.) Thus, a midline shift (as recited in the ’444 patent) is contemplated and a POSITA practicing Chishti ’511 in view of Chishti ’876 would have used a mid-line shift pattern in some circumstances. (Ex. 1003 ¶¶ 86-89.)
12. The computer-implemented method of claim 1, wherein, determining the order of movement step comprises staggering the movement of at least two dental objects.	As discussed with regard to claim 1, Chishti ’876 states “Considerations on when a tooth may be moved include…which teeth need to be moved before others are moved.” (Ex. 1004; 11:43-60.) As would be understood by a POSITA, this is equivalent to staggering as discussed above, meaning determining movement patterns so that movement of particular teeth does not occur at the same time due to situations barring movement of the delayed tooth, and would have been obvious to use in Chishti ‘511, depending on a patient’s individual orthodontic situation. (Ex. 1003 ¶¶ 72-73.)
13. The computer-implemented method of claim 1, wherein determining the order of movement step comprises, round tripping at least one	As discussed with regard to claims 1 and 5, Chishti ’511 explicitly discloses round-tripping. (Ex. 1005, 4:7-16; Ex. 1003, ¶ 81-85.)

dental object.	
14. The computer-implemented method of claim 1, wherein determining the order of movement step comprises, slowing the movement of at least one dental object.	Although Chishti '511 does not explicitly teach slowing down the movement of a particular tooth, this was well-known in the art. Chishti '876 discloses slowing the movement of at least one tooth, and thus teaches determining an order of movement that includes slowing the movement of at least one tooth. (Ex. 1004; 12:23-32.) > One component may accelerate along a curve between one pair of stages…, while another moves linearly between another pair of stages (e.g., stages 1 to 5), and then changes direction suddenly and slows down along a linear path to a later stage (e.g., stage 10). (Ex. 1004, 12:25-31.) Accordingly, slowing the movement of at least one dental object would implemented by a POSITA in Chishti '511 in view of Chishti '876, as a known and predictable technique of orthodontic treatment.
15. A system for staging the movement of a plurality of dental objects, the system comprising: means for receiving an electronic representation of each dental object of the plurality of dental objects in relation to one another; means for receiving an electronic representation of a desired final position for each respective dental object; and means for determining an order	*See* claim construction of the "means for" in Section VI(E) above. *See* discussion above for claim 1. Chishti '511 describes a computer configured to perform these steps. (*See, e.g.*, Ex. 1005, 2:34-39, 3:36-39, 10:19-51.)

of movement for each respective dental object such that the dental objects avoid colliding with each other on their respective routes from said initial position to said desired final position.	
16. The system of claim 15, wherein the means for determining the order of movement comprises: (a) means for determining a route each respective dental object will move to achieve its respective final position; (b) means for determining the distance each respective dental object will move to achieve its respective final position; and (c) means for determining a rate at which each respective dental object will move along its respective route.	*See* discussion above for claim 2.
17. The system of claim 16, further comprising means for determining (a), (b), and (c) in relation to each of the other dental objects.	*See* discussion above for claim 3.
18. The system of claim 17, wherein the means for determining (a), (b), and (c) in relation to each of the other dental objects comprises means for adjusting at least one of the route and the rate of at least one dental object to avoid collision with at least one other dental object.	*See* discussion above for claim 4.
19. The system of claim 15, further comprising means for	*See* discussion above for claim 5.

determining an optimal number of stages for the order of movement of the dental objects.	
20. The system of claim 19, wherein the means for determining the optimal number of stages step comprises: means for determining a total distance each respective dental object will move; means for dividing the total distance for each dental object by its respective maximum speed to determine a number of movement stages for each dental object; means for determining a number of non-movement stages for each respective dental object; means for adding the number of movement stages to the number of non-movement stages for each dental object to determine a minimum number of stages for each respective dental object; and means for selecting the largest of the minimum number of stages.	*See* discussion above for claim 6.
21. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects in an all-equal pattern.	*See* discussion above for claim 7.
22. The system of claim 15,	*See* discussion above for claim 8.

wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects in a V-shaped pattern.	
23. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects in an A-shaped pattern.	*See* discussion above for claim 9.
24. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects to form an M-shaped pattern.	*See* discussion above for claim 10.
25. The system of claim 15, wherein the means for determining the order of movement comprises means for ordering the movement of the dental objects in a mid-line shift pattern.	*See* discussion above for claim 11.
26. The system of claim 15, wherein the means for determining the order of movement comprises means for staggering the movement of at least two dental objects.	*See* discussion above for claim 12.
27. The system of claim 15, wherein the means for determining the order of movement comprises means for round tripping at least one dental object.	*See* discussion above for claim 13.
28. The system of claim 15,	*See* discussion above for claim 14.

wherein the means for determining the order of movement comprises means for slowing the movement of at least one dental object.	
29. A machine-readable medium having stored thereon a plurality of instructions for staging the movement of a plurality of dental objects, the plurality of instructions when executed by a processor, causing the processor to: receive an electronic representation of each dental object in relation to one another in an initial position; receive an electronic representation of a desired final position for each respective dental object; and determine an order of movement for each respective dental object such that the dental objects avoid colliding with each other on their respective routes from said initial position to said desired final position.	*See* discussion above for claim 1. Chishti '511 describes a computer-implemented system for carrying out each of these steps. (2:34-39, 3:36-39, 10:19-51.)

30. The machine-readable medium of claim 29, wherein the instructions causing the processor to determine the order of movement instructions further comprise instructions to: (a) determine a route each respective dental object will move to achieve its respective final position; (b) determine the distance each respective dental object will move to achieve its respective final position; and (c) determine a rate at which each respective dental object will move along its respective route.	*See* discussion above for claim 2.
31. The machine-readable medium of claim 30, further comprising instructions to: determine (a), (b), and (c) in relation to each of the other dental objects.	*See* discussion above for claim 3.
32. The machine-readable medium of claim 31, wherein the instructions to determine (a), (b), and (c) in relation to each of the other dental objects comprises instructions to adjust at least one of the route and the rate of at least one dental object to avoid collision with at least one other dental object.	*See* discussion above for claim 4.
33. The machine-readable medium of claim 29, further comprising instructions to determine an optimal number of stages for the order of	*See* discussion above for claim 5.

movement of the dental objects.	
34. The machine-readable medium of claim 33, wherein the instructions to determine the optimal number of stages comprise instructions to: determine a total distance each respective dental object will move; divide the total distance for each dental object by its respective maximum speed to determine a number of movement stages for each dental object; determine a number of non-movement stages for each respective dental object; add the number of movement stages to the number of non-movement stages for each dental object to determine a minimum number of stages for each respective dental object; and select the largest of the minimum number of stages.	*See* discussion above for claim 6.
35. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to order the movement of the dental objects to form an all-equal pattern.	*See* discussion above for claim 7.
36. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement	*See* discussion above for claim 8.

comprise instructions to order the movement of the dental objects to form a V-shaped pattern.	
37. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement, comprise instructions to order the movement of the dental objects to form an A-shaped pattern.	*See* discussion above for claim 9.
38. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to order the movement of the dental objects to form an M-shaped pattern.	*See* discussion above for claim 10.
39. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to order the movement of the dental objects a mid-line shift pattern.	*See* discussion above for claim 11.
40. The machine-readable medium of claim 29, wherein the instructions to determining the order of movement, comprise instructions to stagger the movement of at least two dental objects.	*See* discussion above for claim 12.
41. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to round-trip at least one dental object.	*See* discussion above for claim 13.

42. The machine-readable medium of claim 29, wherein the instructions to determine the order of movement comprise instructions to slow the movement of at least one dental object.	*See* discussion above for claim 14.

Accordingly, the evidence presented above demonstrates that Petitioner has clearly addressed the following *Graham* factors to resolve the issue of obviousness, including (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; and (3) the differences between the claimed invention and the prior art, and has at least a reasonable likelihood of prevailing on the above ground. *Graham v. John Deere Co.,* 383 U.S. 1 (1966).

VIII. CONCLUSION

Substantial, new and noncumulative technical teachings have been presented for each of claims 1-42 of the '444 patent, which claims are rendered obvious for the reasons set forth above. There is a reasonable likelihood that Petitioner will prevail as to each of these claims. *Inter partes* review of claims 1-42 is accordingly requested.

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned certifies service pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(b) on the Patent Owner by U.S.P.S. Express Mail of a copy of this Petition for *Inter Partes* Review and supporting materials at the correspondence address of record for the ’444 patent to:

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CERTIFICATE OF COMPLIANCE

The undersigned certifies this document complies with the type-volume limitation of 37 C.F.R. § 42.24. The petition contains 13,890 words, as calculated by the Microsoft Word program excluding the parts of the brief exempted by 37 C.F.R. § 42.24(a).

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