UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEARCORRECT OPERATING LLC,
Petitioner,

v.

ALIGN TECHNOLOGY INC.,
Patent Owner.

Case IPR2025-00814
Patent No. 10,456,217

PETITION FOR *INTER PARTES* REVIEW

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1. [1(pre)] A method comprising: 32

2. [1(a)] selecting a movement pattern from a plurality of movement patterns for moving dental objects from an initial arrangement toward a final arrangement, the dental objects being based on output of a scanning device, the movement pattern defining a schedule of movement of the dental objects during treatment stages as each of the dental objects moves from a respective initial position toward a respective final position; 32

3. [1(b)] calculating, by a computer processor, a respective treatment path for each of the dental objects between its respective initial and final positions; 38

4. [1(c)] identifying, by a computer processor, a collision between a first of the dental objects and a second of the dental objects based at least on one of the respective treatment paths; and 39

5. [1(d)] performing, by a computer processor, a first modification of the schedule of movement in response to the identifying, the first modification comprising: 41

6. [1(e)] round-tripping the first dental object. 44

B. Claim 2: The method of claim 1, wherein the movement pattern is selected by a user. 49

C. Claim 3: The method of claim 1, wherein the selecting comprises analyzing, by a computer processor, the dental objects in their respective initial and final positions. 49

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E. Claim 5 53

1. [5(a)] The method of claim 1, further comprising: determining, by a computer processor, that the first modification does not avoid a collision between the first and second dental objects; and 53

2. [5(b)] performing, by a computer processor after the determining, a second modification of the schedule of movement, the second modification comprising slowing or stopping movement of the first dental object during one or more of the treatment stages following a previous one of the treatment stages in which the first dental object moved. 57

F. Claim 6 62

1. [6(a)] The method of claim 5, further comprising: determining, by a computer processor, that the second modification does not avoid a collision between the first and second dental objects; and 62

2. [6(b)] performing, by a computer processor after determining that the second modification does not avoid a collision, a third modification of the schedule of movement, the third modification comprising round-tripping the first dental object. 62

G. Claim 7 64

1. [7(a)] The method of claim 1, further comprising: determining, by a computer processor, that the first modification does not avoid a collision between the first and second dental objects; and.....64

2. [7(b)] performing, by a computer processor after the determining, a second modification of the schedule of movement, the second modification comprising round-tripping the first dental object. 64

H. Claim 8: The method of claim 1, further comprising producing a series of orthodontic appliances based at least on the modified schedule of movement, wherein each of the orthodontic appliances corresponds to a respective one of the treatment stages. 65

I. Claim 9 66

1. [9(a)] The method of claim 8, wherein the producing comprises: fabricating a respective positive mold of the dental objects for at least two of the treatment stages; and 66

2. [9(b)] thermoforming a respective one of the orthodontic appliances over each of the respective positive molds. 67

J. Claim 10 69

1. [10(a)] The method of claim 1, further comprising: performing, by a computer processor, a second modification of the schedule of movement in response to the identifying, the second modification comprising one or more of:.....69

2. [10(b)] delaying initial movement of the first dental object; and.....70

3. [10(c)] slowing or stopping movement of the first dental object during one or more of the treatment stages

following a previous one of the treatment stages during which the first dental object moved. 72

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LIST OF EXHIBITS

Exhibit No.	Description
Ex-1001	U.S. Patent No. 10,456,217 to Kitching et al. ("'217 patent")
Ex-1002	Prosecution History of U.S. Patent No. 10,456,217
Ex-1003	Declaration of Dr. Sumit Yadav
Ex-1004	U.S. Patent No. 6,471,511 to Chishti et al. ("Chishti-511")
Ex-1005	U.S. Patent No. 6,729,876 to Chishti et al. ("Chishti-876")
Ex-1006	Adrian Becker, *The Orthodontic Treatment of Impacted Teeth* (Martin Dunitz Ltd. 1998) ("Becker")
Ex-1007	U.S. Patent No. 6,250,918 to Sachdeva et al. ("Sachdeva")
Ex-1008	*ClearCorrect Operating LLC v. Align, Inc.*, IPR2017-01829, Decision Denying Institution, Paper 10 (PTAB Feb. 5, 2018)
Ex-1009	Speaker Profile of Rohit Sachdeva, retrieved from: https://www.emedevents.com/speaker-profile/rohit-sachdeva
Ex-1010	LinkedIn Profile of Ruedger Rubbert, retrieved from: https://www.linkedin.com/in/ruedger-rubbert-6136b119
Ex-1011	LinkedIn Profile of Ian Kitching, retrieved from: https://www.linkedin.com/in/ian-kitching-3961333
Ex-1012	LinkedIn Profile of Alexander Dmitriev, retrieved from: https://www.linkedin.com/in/alexander-dmitriev-5145991
Ex-1013	*Align Technology, Inc. v. ClearCorrect Operating, LLC, et al.*, Case No. 6:24-cv-00187-ADA-DTG, Dkt. 142, Joint Claim Construction Statement (W.D. Tex. Jan. 3, 2025)
Ex-1014	Harold D. Kesling, *The Diagnostic Setup with Consideration of the Third Dimension*, Am. J. Orthodontics, Vol. 42, No. 10, pp. 740-48 (Oct. 1956)

Exhibit No.	**Description**
Ex-1015	H.D. Kesling, *Coordinating the Predetermined Pattern and Tooth Positioner with Conventional Treatment*, presented at the meeting of the Southern Society of Orthodontists, pp. 285-93 (Jan. 28-29, 1946)
Ex-1016	Orhan C. Tuncay (ed.), *The Invisalign System* (Quintessence Publishing Co., Ltd. 2006)
Ex-1017	Declaration of Dr. Paul C. Clark
Ex-1018	U.S. Patent No. 6,702,575 to Hilliard
Ex-1019	U.S. Patent No. 6,309,215 to Phan et al.
Ex-1020	Declaration of Kelley M. Hayes Greenhill Regarding Ex-1006
Ex-1021	Declaration of Kelley M. Hayes Greenhill Regarding Ex-1016
Ex-1022	Stanley A. Alexander, *Levels of root resorption associated with continuous arch and sectional arch mechanics*, Am. J. Orthodontics and Dentofacial Orthopedics, Vol. 110, No. 3, pp. 321-24 (Sept. 1996)
Ex-1023	DeAngelis, Vincent, *The Amalgamated Technique, a Mechanically and Biologically Efficient Method for Controlled Tooth Movement* (1980)
Ex-1024	Hyo-Sang Park et al., *Group Distal Movement of Teeth Using Microscrew Implant Anchorage*, Angle Orthodontist, Vol. 75, No. 4, pp. 602-09 (2005)
Ex-1025	RESERVED
Ex-1026	RESERVED
Ex-1027	RESERVED

Exhibit No.	**Description**
Ex-1028	*ClearCorrect Operating, LLC v. Align Technology, Inc.*, IPR2017-01829, Petition for *Inter Partes* Review of U.S. Patent No. 8,038,444, Paper 1 (PTAB July 20, 2017)
Ex-1029	Curriculum Vitae of Dr. Sumit Yadav
Ex-1030	Curriculum Vitae of Dr. Paul C. Clark

LIST OF CHALLENGED CLAIMS

Claim 1	
1(pre)	A method comprising:
1(a)	selecting a movement pattern from a plurality of movement patterns for moving dental objects from an initial arrangement toward a final arrangement, the dental objects being based on output of a scanning device, the movement pattern defining a schedule of movement of the dental objects during treatment stages as each of the dental objects moves from a respective initial position toward a respective final position;
1(b)	calculating, by a computer processor, a respective treatment path for each of the dental objects between its respective initial and final positions;
1(c)	identifying, by a computer processor, a collision between a first of the dental objects and a second of the dental objects based at least on one of the respective treatment paths; and
1(d)	performing, by a computer processor, a first modification of the schedule of movement in response to the identifying, the first modification comprising:
1(e)	round-tripping the first dental object.
Claim 2	
2	The method of claim 1, wherein the movement pattern is selected by a user.
Claim 3	
3	The method of claim 1, wherein the selecting comprises analyzing, by a computer processor, the dental objects in their respective initial and final positions.

Claim 4	
4	The method of claim 3, wherein the analyzing comprises determining, by a computer processor, a respective distance needed to move each of the dental objects from its respective initial position to its respective final position.
Claim 5	
5(a)	The method of claim 1, further comprising: determining, by a computer processor, that the first modification does not avoid a collision between the first and second dental objects; and
5(b)	performing, by a computer processor after the determining, a second modification of the schedule of movement, the second modification comprising slowing or stopping movement of the first dental object during one or more of the treatment stages following a previous one of the treatment stages in which the first dental object moved.
Claim 6	
6(a)	The method of claim 5, further comprising: determining, by a computer processor, that the second modification does not avoid a collision between the first and second dental objects; and
6(b)	performing, by a computer processor after determining that the second modification does not avoid a collision, a third modification of the schedule of movement, the third modification comprising round-tripping the first dental object.
Claim 7	
7(a)	The method of claim 1, further comprising: determining, by a computer processor, that the first modification does not avoid a collision between the first and second dental objects; and

7(b)	performing, by a computer processor after the determining, a second modification of the schedule of movement, the second modification comprising round-tripping the first dental object.
Claim 8	
8	The method of claim 1, further comprising producing a series of orthodontic appliances based at least on the modified schedule of movement, wherein each of the orthodontic appliances corresponds to a respective one of the treatment stages.
Claim 9	
9(a)	The method of claim 8, wherein the producing comprises: fabricating a respective positive mold of the dental objects for at least two of the treatment stages; and
9(b)	thermoforming a respective one of the orthodontic appliances over each of the respective positive molds.
Claim 10	
10(a)	The method of claim 1, further comprising: performing, by a computer processor, a second modification of the schedule of movement in response to the identifying, the second modification comprising one or more of:
10(b)	delaying initial movement of the first dental object; and
10(c)	slowing or stopping movement of the first dental object during one or more of the treatment stages following a previous one of the treatment stages during which the first dental object moved.
Claim 11[1]	

[1] *See* Certificate of Correction issued August 11, 2020.

11(pre)	A non-transitory computer-readable medium comprising instructions that, when executed by one or more computer processors, cause at least one of the one or more processors to:
11(a)	select a movement pattern from a plurality of movement patterns for moving dental objects from an initial arrangement toward a final arrangement, the dental objects being based on output of a scanning device, the movement pattern defining a schedule of movement of the dental objects during treatment stages as each of the dental objects moves from a respective initial position toward a respective final position;
11(b)	calculate a respective treatment path for each of the dental objects between its respective initial and final positions;
11(c)	identify a collision between a first of the dental objects and a second of the dental objects based at least on one of the respective treatment paths; and
11(d)	perform a first modification of the schedule of movement in response to the identifying, the first modification comprising:
11(e)	round-tripping the first dental object.
Claim 12	
12	The medium of claim 11, wherein the movement pattern is selected by a user.
Claim 13	
13	The medium of claim 11, wherein the selecting comprises analyzing the dental objects in their respective initial and final positions.
Claim 14	
14	The medium of claim 13, wherein the analyzing comprises determining a respective distance needed to move each of the

	dental objects from its respective initial position to its respective final position.
Claim 15	
15(a)	The medium of claim 11, wherein the instructions, when executed by the one or more processors, further cause at least one of the one or more processors to: determine that the first modification does not avoid a collision between the first and second dental objects; and
15(b)	perform, after the determining, a second modification of the schedule of movement, the second modification comprising slowing or stopping the movement of the first dental object during at least one of the treatment stages following a previous one of the treatment stages during which the first dental object moved.
Claim 16	
16(a)	The medium of claim 15, wherein the instructions, when executed by the one or more processors, further cause at least one of the one or more processors to: determine that the second modification does not avoid a collision between the first and second dental objects; and
16(b)	perform, after determining that the second modification does not avoid a collision, a third modification of the schedule of movement, the third modification comprising round-tripping the first dental object moved.
Claim 17	
17(a)	The medium of claim 11, wherein the instructions, when executed by the one or more processors, further cause at least one of the one or more processors to: determine that the first modification does not avoid a collision between the first and second dental objects; and

17(b)	perform, after the determining, a second modification of the schedule of movement, the second modification comprising round-tripping the first dental object.
Claim 18	
18	The medium of claim 11, wherein the instructions, when executed by the one or more processors, further cause at least one of the one or more processors to produce a series of orthodontic appliances based at least on the modified schedule of movement, wherein each of the orthodontic appliances corresponds to a respective one of the treatment stages.
Claim 19	
19(a)	The medium of claim 18, wherein the producing comprises: fabricating a respective positive mold of the dental objects for at least two of the treatment stages; and
19(b)	thermoforming a respective one of the orthodontic appliances over each of the respective positive molds.
Claim 20	
20(a)	The method of [claim] 11, further comprising: performing, by a computer processor, a second modification of the schedule of movement in response to the identifying, the second modification comprising one or more of:
20(b)	delaying initial movement of the first dental object; and
20(c)	slowing or stopping movement of the first dental object during one or more of the treatment stages following a previous one of the treatment stages during which the first dental object moved.

I. INTRODUCTION

U.S. Patent No. 10,456,217 ("'217 patent") is directed to software for generating orthodontic treatment plans for use with clear aligners. Ex-1001, Abstract. The '217 patent admits that generating a treatment plan for clear aligners was well known when the patent was filed. Ex-1001, 1:33-39. The '217 patent does not assert any technical advancement or any new methods of treatment. Instead, the "need" it purportedly met was "to increase automation of a tooth movement treatment planning process." Ex-1001, 2:1-5. But all the claimed automated techniques were known in the prior art.

The primary reference asserted (Chishti-511) discloses a computerized system that receives digital representations of a patient's teeth and generates a treatment plan for clear aligners. The other cited references disclose well-known features that would have been obvious components of an automated software treatment-planning system. Chishti-876 discloses a database of established treatment patterns for creating well-known treatment plans. Sachdeva discloses an automated, computerized system that identifies when a treatment plan may have a collision between teeth and automatically modifies the plan to avoid collisions. Finally, Becker, which was not considered during prosecution, discloses the particular collision-avoidance technique that was the basis for allowance of the '217

patent: round-tripping. Becker shows that round-tripping has long been known and applied by trained orthodontists in the same manner discussed in the ’217 patent.

A person of ordinary skill in the art (“POSITA”) would have been motivated to combine Chishti-511 with the other references, so the ’217 patent’s claims are unpatentable as obvious. Petitioner requests that the Board institute an *inter partes* review and cancel claims 1-20.

II. RELIEF REQUESTED

Petitioner ClearCorrect Operating LLC requests review and cancellation of claims 1-20 of the ’217 patent based on the following grounds:

Exhibit	**Reference**	**Prior-Art Status**[2]
Ex-1004	U.S. Patent No. 6,471,511 (“Chishti-511”), issued October 29, 2002	§ 102(b)
Ex-1005	U.S. Patent No. 6,729,876 (“Chishti-876”), issued May 4, 2004	§ 102(b)

[2] Prior-art status has been assessed under pre-AIA 35 U.S.C. § 102. The ’217 patent claims priority to a provisional application filed August 30, 2006. Ex-1001, p.2, (60). While Petitioner does not concede that the ’217 patent is entitled to this priority date, all asserted references qualify as prior art by this date.

Exhibit	Reference	Prior-Art Status[2]
Ex-1006	Adrian Becker, *The Orthodontic Treatment of Impacted Teeth* ("Becker"), published 1998[3]	§ 102(b)
Ex-1007	U.S. Patent No. 6,250,918 ("Sachdeva"), issued June 26, 2001	§ 102(b)

Ground	Claims Challenged	35 U.S.C.	References
1	1-20	§ 103	Chishti-511, Chishti-876, Sachdeva, Becker

III. THE '217 PATENT

A. Overview

The '217 patent describes a computerized system for scheduling moving teeth in stages from an initial to a final position, according to various movement patterns and orthodontic techniques. Ex-1001, 2:10-22. Using a scan of the patient's teeth in an initial state, the computer generates a digital model of the teeth. Ex-1001, 5:25-53. A digital model of the patient's teeth at a final position is then defined. Ex-1001, 3:54-60, 5:30-32. The computer determines a movement path for each of the

[3] Becker was publicly available at least by April 30, 1998. Ex-1020, ¶¶11-20.

patient's teeth from initial to final positions. Ex-1001, 3:54-4:3, 5:32-41. Ex-1003, ¶¶35-36.

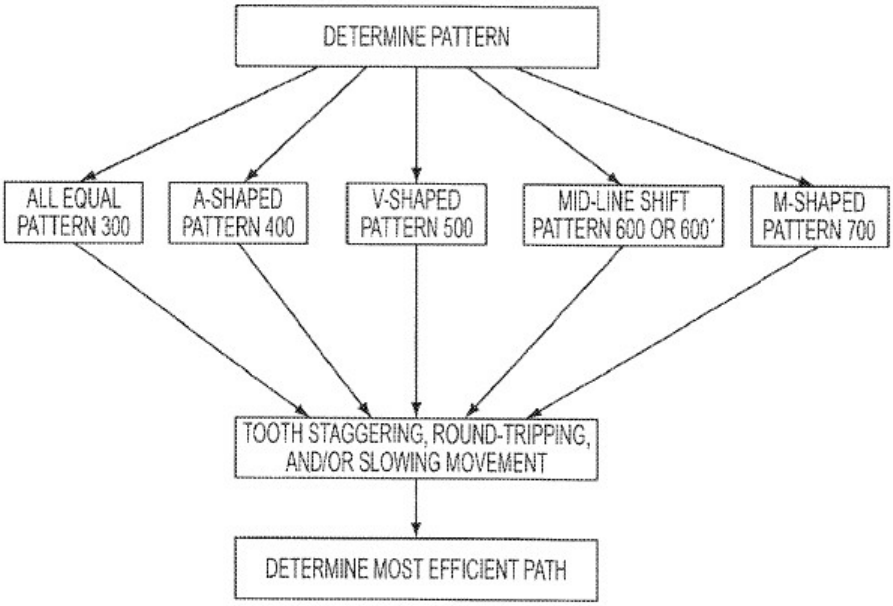


FIG. 2B

Ex-1001, Fig. 2B.

As shown above, one of various teeth movement patterns is initially selected. Ex-1001, 5:55-6:3, Figs. 3-9. The system then determines whether the pattern would result in collisions between teeth. Ex-1001, 6:41-45. The '217 patent admits that both pattern selection and collision detection are disclosed in Chishti-876. Ex-1001, 6:8-14, 6:45-52; Ex-1003, ¶¶38-40.

If a collision is detected, the system modifies the treatment plan using known collision-avoidance techniques, such as "[s]taggering," "[s]lowing down," and "[r]ound-tripping." Ex-1001, 12:66-13:11. "Round-tripping" is "the technique of

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, 13:7-11. The '217 patent states that staggering, slowing down, and/or round-tripping can be applied "alone or in combination, and in any order." Ex. 1001, 13:11-13. But in the only exemplary embodiment incorporating all three techniques, the patent describes using staggering first, followed by "slowing-down," and only using "round-tripping ***as a last resort***." Ex-1001, 13:11-17 (emphasis added). Ex-1003, ¶40.

While the '217 patent describes a specific manner of round-tripping, it does not purport to have invented this (or any) form of round-tripping. Nor does the patent identify any benefits of round-tripping. Instead, as noted above, round-tripping is described in the patent as "a last resort," which indicates that despite the risks that a POSITA would have known to be associated with it, round-tripping may be a clinically necessary and acceptable technique in some circumstances. Ex-1001, 12:61-62; Ex-1003, ¶41.

B. Prosecution History

U.S. Application No. 15/834,608 (the "'608 application") issued as the '217 patent and stems from two provisional patent applications filed by Align on August

30, 2006. Align filed the first nonprovisional parent in the family in 2007, and it issued in 2011 as U.S. Patent No. 8,038,444 (the "'444 patent").

During prosecution of the '608 application, the Office initially rejected all claims over two publications to Chishti—Chishti-511 and U.S. Patent Publication No. 2004/0137400 (Chishti-400)—and one to Phan (U.S. Patent No. 6,309,215). Ex-1002, 129-43.

Prior to Align filing the '608 application, ClearCorrect filed IPR2017-01829 (the "'444 IPR"), challenging the '444 patent's claims in view of Chishti-876 alone and in combination with Chishti-511. Ex. 1028. While the '608 application was pending, the Board denied the '444 IPR institution based on, among other things, the definition of "round-tripping" in the specification of the '444 patent, which the Board determined was not explicitly disclosed in the Chishti references. *See generally* Ex-1008.

In response to the prior-art rejections against the '608 application, Align submitted an IDS listing the Board's decision denying institution of the '444 IPR, and argued that the pending claims were allowable under the Board's interpretation in the '444 IPR. *See* Ex-1002, 207-27.

While the Office largely maintained its rejections based on the Chishti references, it allowed certain claims reciting "round-tripping," explaining that the

allowability of the claims was "limited to the definition of [round-tripping] found in the specification"—i.e., "the technique of 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-1002, 246. The '217 patent issued after Align authorized an Examiner's amendment that recited round-tripping in the independent claims. Ex-1002, 302-08. The Office never considered Becker, which discloses the specific type of "round-tripping" defined in the '217 patent. Ex-1003, ¶¶42-45.

IV. LEVEL OF ORDINARY SKILL IN THE ART

A POSITA pertinent to the '217 patent as of the August 30, 2006 claimed priority date would have been part of an interdisciplinary team. This team would have included a member with an advanced degree related to dentistry (e.g., BDS, MDS, DDS, DMD) with experience in orthodontics, including 1-3 years of orthodontic training or equivalent experience, and experience using clear aligners. The team may have also included members with a degree in a technical area related to software, graphics, computers, or a related discipline. This technical team member would have had 1-3 years of software development experience. For all team members, more education could substitute for experience and vice versa. Ex-1003, ¶¶23-24, Ex-1017, ¶¶23-25; Ex-1029; Ex-1030.

In its petition in the ’444 IPR, ClearCorrect proposed that a POSITA would have had a doctorate in dental science and 3-5 years of training and practical experience in orthodontics. Ex-1028, 13. While this person would qualify as a POSITA, additional information indicates that the level of ordinary skill would include members of an interdisciplinary team. Ex. 1003, ¶¶24, 27-28.

For example, at least two inventors of the ’217 patent (Ian Kitching and Alexander Dmitriev) appear to have backgrounds in computer science, but no dental degree. *See* Ex-1011; Ex-1012. Similarly, Sachdeva—a highly relevant prior-art reference not previously considered by the Office—includes two inventors: Rohit Sachdeva and Rudger Rubbert. Ex-1007. They exemplify the interdisciplinary team discussed above because Rohit Sachdeva is an orthodontist (*see* Ex-1009), and Rudger Rubbert is a mechanical engineer (*see* Ex-1010). The level of ordinary skill in the art proposed in this Petition is thus consistent with the ’217 patent and the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (prior art itself may reflect an appropriate skill level); *TikTok Inc. v. Cellspin Soft, Inc.*, IPR2024-00767, Paper 8, 19 (PTAB Oct. 1, 2024). Ex. 1003, ¶¶26-27.

V. CLAIM CONSTRUCTION

The Board construes claims according to *Phillips v. AWH Corp*., 415 F.3d 1303 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.200(b). The ground presented herein renders the claims obvious under any construction consistent with *Phillips*.[4]

In the related district-court litigation, the parties agreed to the following constructions relevant to the '217 patent's claims:

round[-]tripping / round-trip claims 1, 6, 7, 11, 16, 17	[moving / move] a first tooth out of the path of a second tooth, and once the second tooth has moved sufficiently, [moving / move] the first tooth back to its previous position before proceeding to a desired final position of that first tooth
slowing / slow claims 5, 10, 15, 20	[having / have] one or more teeth scheduled to move at a rate less than the rate of other teeth, or even [stopping / stop] using interim key frames, so that collisions and/or obstructions do not occur

Ex-1013, 8; Ex-1003, ¶32.[5] These constructions mirror Applicant's definitions of "round[-]tripping" and "slowing" recited in the '217 patent's specification and are applied in the grounds presented herein. *See* Ex-1001, 13:3-11; Ex-1003, ¶33.

[4] Petitioner does not concede that any claim term meets the statutory requirements of 35 U.S.C. §§ 101, 112.

[5] While the district court also addressed other terms, this Petition addresses only terms in the '217 patent claims.

VI. PRIOR ART OVERVIEW

A. Chishti-511 (Ex-1004)

Chishti-511 discloses a system for segmenting an orthodontic treatment plan into a sequence of steps. Ex-1004, Abstract. The system generates a digital model of the patient's teeth and defines a series of treatment steps to be used with aligners, where the steps incrementally move the teeth from an initial position to a final position. Ex-1004, Fig. 1, 3:32-5:6; Ex-1003, ¶¶46-47.

Chishti-511 also discloses that tooth path segments should be defined such that "moving from one point to the next in the sequence does not result in a collision of teeth." Ex-1004, 4:7-22. Chishti-511 explains that while round-tripping first moves a tooth in a "direction other than directly toward the desired final position," it "is sometimes necessary to allow teeth to move past each other." Ex-1004, 4:13-16. Ex-1003, ¶¶48-49.

Chishti-511 emphasizes that the process for defining tooth paths and calculating a shape for the aligners is an iterative process, as shown below. Ex-1004, 4:27-50, 5:21-43, 8:42-66, Figs. 1, 2.

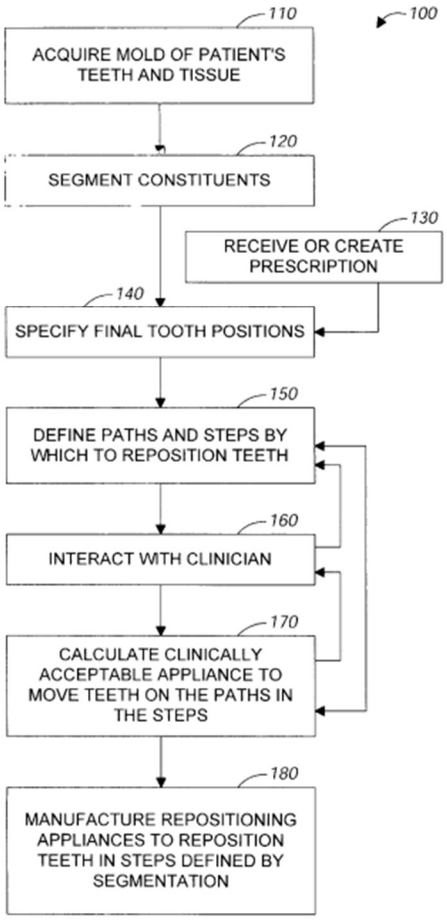


FIG. 1

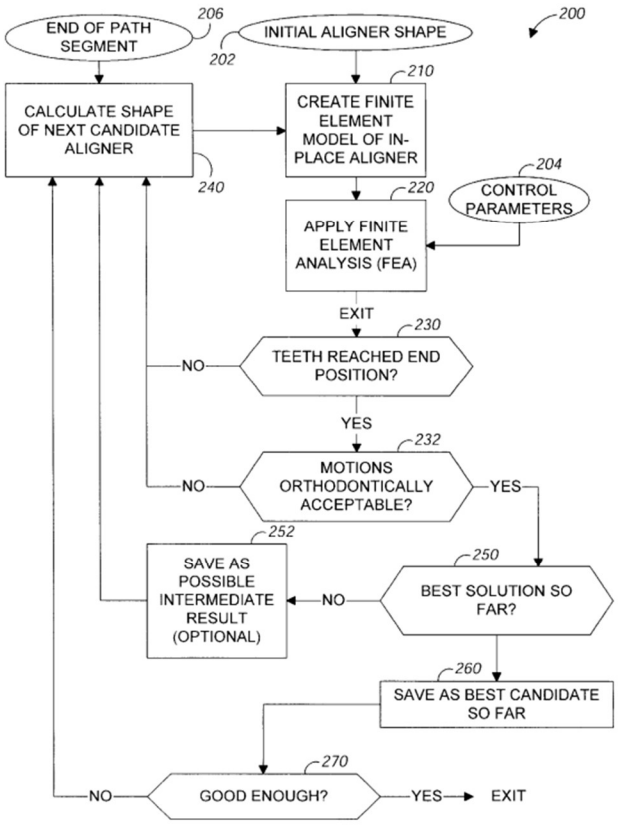


FIG. 2

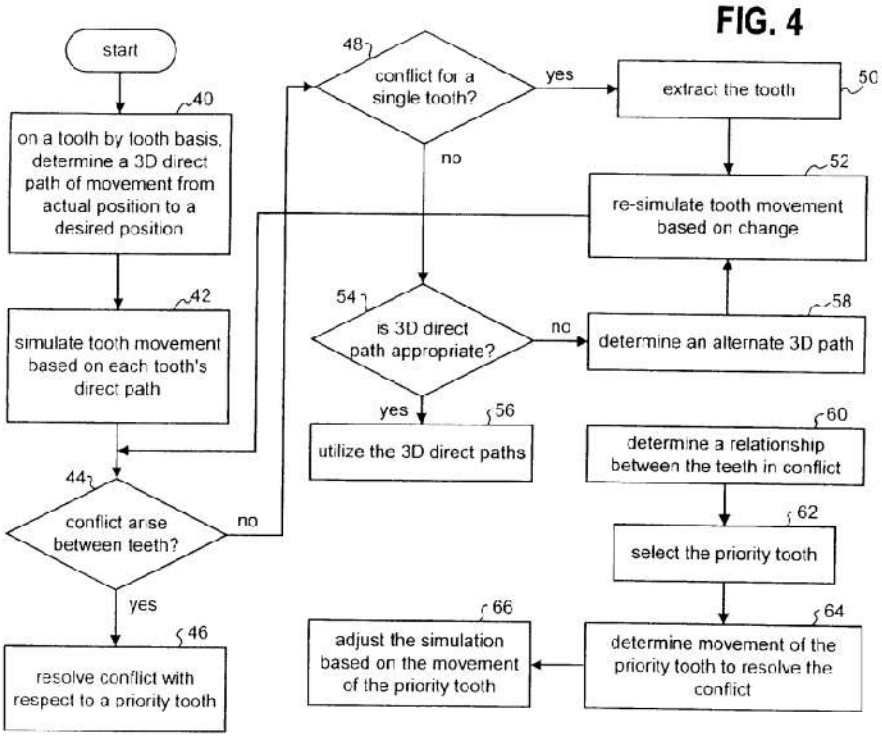
If the proposed aligner shape does not satisfy the requisite criteria, or changes are made, the subprocess of defining the segmented paths is repeated. Ex-1004, 4:27-35, 8:42-66 ("After the treatment path has been redefined, the outer loop of the overall process is executed again."); Ex-1003 ¶¶49-53; Ex-1017 ¶¶35-39. This allows for repeated modifications "to redefine those parts of the treatment path having unacceptable aligners." Ex-1004, 8:42-66; Ex-1003, ¶50.

B. Chishti-876 (Ex-1005)

Chishti-876 discloses a system for preparing a treatment plan that involves selecting and using a treatment pattern. Ex-1005, Abstract, 2:15-19. Chishti-876 discloses that its algorithm "draw[s] upon a database of preferred treatments," which is based on prior successful treatments. Ex-1005, 14:63-15:1. The algorithm can "create several alternative paths and present each path graphically to the user." Ex-1005, 15:1-3. Chishti-876 further discloses the well-known, routine method of manufacturing aligners by thermoforming over a positive mold. Ex-1005, 7:54-64. Ex-1003, ¶¶54-57; Ex-1017, ¶¶40-46.

C. Sachdeva (Ex-1007)

Sachdeva discloses a system for orthodontic treatment planning that simulates tooth movement to identify a "conflict" between two teeth. Ex-1007, Abstract, 4:50-5:8. A "conflict" arises when "the movement of one tooth interferes with the direct path movement of another tooth[,] causing a particular tooth to not be able to obtain its desired position." Ex-1007, 5:5-8. If a conflict is detected, the computer automatically resolves the conflict by modifying the scheduled tooth movement, for example by delaying one tooth's movement while moving another tooth, and adjusting the simulation. Ex-1007, 3:43-48, 4:50-5:5, 5:22-32.



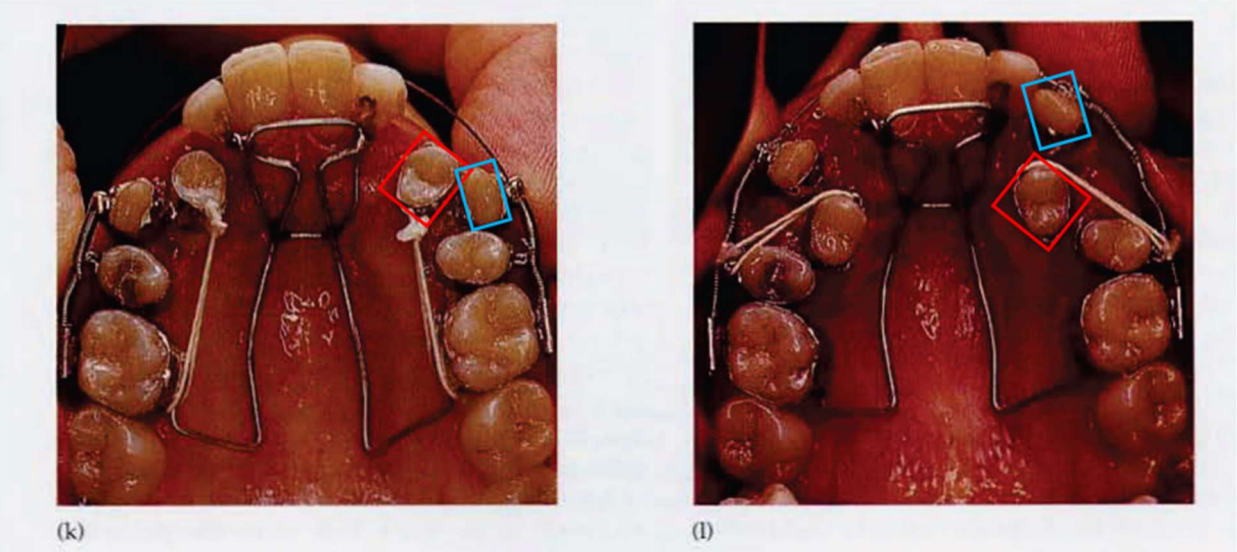
Ex-1007, Fig. 4; Ex-1003, ¶¶58-60; Ex-1017, ¶¶47-51.

D. Becker (Ex-1006)

Becker discloses repositioning a tooth using a round-tripping technique to avoid collisions. Ex-1006, Title, 5; Ex-1003, ¶¶62-65. Becker explains that where a patient's teeth are "transposed"—a dental anomaly also known as an ectopic tooth where a tooth is located in a position normally occupied by a different tooth (Ex-1003, ¶¶60-61)—the "preferred line of treatment" may include "retranspos[ing] [the teeth] to their ideal positions" rather than "align[ing] the teeth in their transposed positions." Ex-1006, 5.

Becker discloses a method for treating this type of malocclusion. Below are images of a patient's teeth, where a more lingual tooth (i.e., a tooth closer to the tongue, in red) is initially transposed with a more buccal tooth (i.e., a tooth closer to the cheek, in blue).[6]

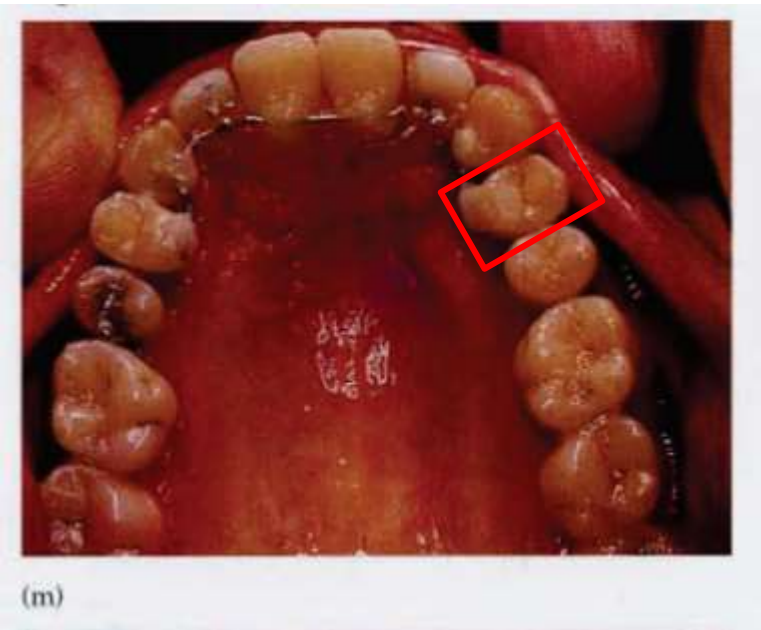
[6] Becker describes the tooth shown in the upper dental arch as a "lingual" tooth and describes movement of that tooth toward the center of the mouth as "lingual" movement (i.e., toward the tongue). Ex-1006, 5. But a POSITA would understand that when referencing teeth in the upper arch, movement to the center of the mouth is generally described as "palatal" movement, and that "lingual" movement is used when referencing teeth in the lower arch. Ex-1003, ¶62 n.1. Petitioner uses the "lingual" terminology from Becker, but a POSITA would recognize that Becker's technique applies to teeth in either the upper or lower dental arch. *Id.*



Ex-1006, 7 (Figs. 8.6(k), (l) (annotated)). The more buccal tooth should be in the position shown on the right, but the more lingual tooth is blocking the direct movement path for the more buccal tooth. Ex-1003, ¶¶62-63.

Becker discloses using round-tripping, as described in the '217 patent, to correct the transposition of the teeth. Becker specifically describes "slid[ing]" the more buccal tooth toward the midline (i.e., "in the mesio-distal plane"). Ex-1006, 5. To allow for this, the more lingual tooth "must be moved further lingually" in order "to allow its partner to pass by." Ex-1006, 5. Finally, the more lingual tooth "must be moved ***in the opposite mesio-distal direction and back in the line of the arch***." *Id.* (emphasis added); Ex-1003, ¶64. Moving the more lingual tooth in the "opposite" direction and "back in the line of the arch" would return the tooth to its previous position, after which the tooth would proceed toward a desired final

position. Ex-1006, 5; Ex-1003, ¶¶64-65. Figure 8.6(m) shows the more lingual tooth after it is further moved to its final position.



Ex-1003, ¶¶63-65 (annotating Ex-1006, 8 (Fig. 8.6(m))).

E. General Overview of Round-Tripping in the Prior Art

Round-tripping—both as a general concept of moving a tooth in a direction other than directly towards its final position, and as the specific type of movement described in the '217 patent where a tooth moves in one direction and then back to its original position before moving to its final position—was a well-known technique at the time of the invention for avoiding collisions between teeth. Ex-1003, ¶66. Through such indirect movements, clinicians create sufficient space for a second tooth to move towards its final position while avoiding collisions. *Id.* Round-tripping was understood to be sometimes necessary in cases involving

crowding or impacted teeth, like Becker, where direct movement of either the first tooth or second tooth is not otherwise possible without causing a collision. *Id.*

A clinician presented with a patient where direct movement of a tooth towards its final position is not possible without causing a collision would consider various tooth movement techniques, including round-tripping, to avoid a collision. Ex-1003, ¶67. A clinician would consider both the risks of roundtripping movement (such as root resorption, loss of periodontal support, and prolonged treatment time caused by the round-tripping movement), as well as the benefit of achieving proper alignment while avoiding a collision. *Id.*

Although it was understood that round-tripping should be avoided if possible, it was also understood to be a necessary option for some patients. Ex-1003, ¶68. For example, Chishti-511 explains that moving a tooth in a "direction other than directly toward the desired final position" "***is sometimes necessary*** to allow teeth to move past each other." Ex-1004, 4:9-16 (emphasis added). In some instances, the only alternative to round tripping might be extraction, which could be even less desirable. Ex-1003, ¶68. This is consistent with the '217 patent's disclosure than round-tripping may be used "as a last resort," Ex-1001, 13:11-17, and with a POSITA's understanding that while it is preferable to avoid ***unnecessary*** indirect

movement techniques, for some patients, some indirect movement may be necessary. Ex-1003, ¶68.

Other publications also confirm that round-tripping was well known. As discussed previously, Becker discloses that the "preferred line of treatment" may include the type of round-tripping specifically required in the '217 patent. Ex-1006, 5. Becker discloses that a tooth is moved out of the way for another tooth to "pass by" before it is moved to its previous and then final positions. *Id.*; *supra* Section VI.D; *infra* Section IX.A.6; Ex-1003, ¶69. Similarly, Park discloses a known movement technique whereby anterior teeth are moved to a forward position and then "retracted back after creating space with the distal movement of the molars and premolars." Ex-1024, 5-6; Ex-1003, ¶69. DeAngelis also discloses a known movement technique where a tooth is tipped such that the root apex moves "from point *a* to point *b*'," and then is "brought back through point *a* to the desirable end-point *b*." Ex-1023, 2; *see also* Ex-1023, Fig. 1B; Ex-1003, ¶69.

In short, the '217 patent's disclosure regarding round-tripping is neither novel nor nonobvious but rather reflects a widespread consensus at the time of the '217 patent that round-tripping was an option to be considered, with advantages and disadvantages, and that round-tripping would be used as necessary if it was the best (or potentially only) available treatment option. Ex-1003, ¶71.

VII. CHISHTI-511, CHISHTI-876, SACHDEVA, AND BECKER ARE ANALOGOUS ART

The asserted references are analogous art to the '217 patent and to each other. Ex-1003, ¶72. The '217 patent "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." Ex-1001, 1:21-23. Each of Chishti-511, Chishti-876, Sachdeva, and Becker is in the same field of endeavor, as each is directed to orthodontic treatment for repositioning misaligned teeth. *See* Ex-1004, Abstract ("orthodontic treatment path into clinically appropriate substeps for repositioning the teeth of a patient"); Ex-1005, Abstract ("prepar[ing] a malocclusion treatment plan"); Ex-1007, Abstract ("simulating tooth movement for an orthodontic patient" and determining "a three-dimensional direct path of movement"); Ex-1006, 5 (discussing teeth movement); Ex-1003, ¶72.

Chishti-511, Chishti-876, Sachdeva, and Becker are also analogous art because they are reasonably pertinent to the problem that the '217 patent purports to solve. Ex-1003, ¶73. The '217 patent alleges that it addresses the problem of potential collisions of teeth along a path for correcting tooth positions. Ex-1001, 1:21-23, 6:41-52 (the system "is configured to determine[] if the pattern should be modified to accommodate the teeth movement of the current patient to avoid collision"), 6:53-60 (discussing avoiding collisions); Ex-1003, ¶73.

The references are reasonably pertinent to this same problem. Ex-1003, ¶74. Chishti-511 discloses "defin[ing] a tooth path for the motion of each tooth" such that the movement "does not result in a collision of teeth." Ex-1004, 4:7-9, 4:18-22. Chishti-876 similarly discloses that "determining a tooth path [which] includes finding a collision[-]free shortest path." Ex-1005, 2:21-30. Sachdeva determines a "path of movement," "determines whether a conflict arises between at least two teeth," and resolves that conflict. Ex-1007, Abstract. Finally, Becker shows a known round-tripping technique used to avoid potential collision of teeth. Ex-1006, 5; Ex-1003, ¶74.

VIII. MOTIVATION TO COMBINE CHISHTI-511, CHISHTI-876, SACHDEVA, AND BECKER

A POSITA would have been motivated to combine the asserted references with a reasonable expectation of success. Ex-1003, ¶¶75-86.

A POSITA would have been motivated to use Sachdeva's and Becker's collision identification and avoidance techniques to supplement Chishti-511's treatment planning system. Chishti-511 discloses that its system generates "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-1004, 4:15-22. Considering this express disclosure, a POSITA would have been motivated to look to teachings regarding the identification and avoidance of collisions. Ex-1003, ¶76.

Sachdeva provides such a teaching. Ex-1003, ¶77. Like Chishti-511, Sachdeva recognizes that collisions are undesirable. *See* Ex-1007, 5:5-8 ("A conflict may arise in that the movement of one tooth interferes with the direct path movement of another tooth[,] causing a particular tooth to not be able to obtain its desired position."). Sachdeva further discloses identifying collisions and resolving them. *See* Ex-1007, 5:3-26, Fig. 4. For example, Sachdeva discloses resolving a conflict by giving one tooth priority to move it before another tooth (delaying one tooth), and further explains how the changes will cause adjustments or recalculations in the simulated treatment. Ex-1007, 5:3-32; Ex-1003, ¶77.

A POSITA would have recognized that integrating Sachdeva's automated collision identification, avoidance, and adjustment features into Chishti-511 would provide implementation details for the features disclosed in Chishti-511 and would help achieve the "clinically viable sequence of tooth positions" sought by Chishti-511—that is, preventing the undesirable result of producing a set of aligners that might otherwise cause a collision. Ex-1003, ¶78. Indeed, the type of collision avoidance disclosed by Sachdeva (delaying an initial movement of a tooth) was a well-known treatment technique at the time of the invention. *See, e.g.*, Ex-1014, 6 (describing repositioning a patient's canine teeth after "the central and lateral incisors are repositioned"); Ex-1015, 5 ("the mandibular teeth should advance

toward the predetermined pattern and stationary anchorage somewhat ahead of the maxillary teeth."); Ex-1016, 124 & Fig. 12-10a (describing a "[h]igh-anchorage pattern," where the anterior teeth are only moved after the posterior teeth have moved)[7]. A POSITA would also have understood that such a system would improve patient results by avoiding unacceptable collisions and increase efficiency by reducing the need for a clinician to manually identify collisions. Ex-1003, ¶78.

A POSITA would have had a reasonable expectation of success in combining Chishti-511 and Sachdeva because each uses similar computer-implemented treatment-planning systems that use digital models of teeth to determine movement paths and avoid collisions between teeth. Ex-1017, ¶¶55-61 (citing Ex-1004, 3:51-58, 5:7-59, 10:19-51; Ex-1007, 4:39-49); Ex-1003, ¶79 (citing Ex-1004, 4:7-22, 5:25-32, 8:22-65; Ex-1007, 5:3-32). Implementing Sachdeva's collision identification and avoidance technique would have merely involved modifying Chishti-511's algorithm for calculating new aligners to include Sachdeva's teachings. Ex-1017, ¶¶56-61 (citing Ex-1004, 3:51-58, 4:7-22, 10:19-51; Ex-1007, 3:36-41, 4:39-49, 5:3-32). Chishti-511 already states that new aligners will be calculated in various circumstances, including where the initial aligners are not

[7] Tuncay was publicly available at least by August 17, 2006. Ex-1021, ¶¶21-37.

acceptable. Ex-1004, 5:25-32; Ex-1017, ¶57. A POSITA would have understood that aligners that produce collisions would not be acceptable, and Sachdeva's collision identification process would have been used as part of determining the acceptability of the aligner (e.g., triggering whether a new aligner should be calculated). Ex-1004, 5:7-32; Ex-1003, ¶79; Ex-1017, ¶¶58-59.

Chishti-511 further explains that changes in teeth motion may be part of the path redefinition, and a POSITA would understand these changes may include Sachdeva's disclosed collision avoidance process and subsequent path adjustments. Ex-1017, ¶¶59-61 (citing Ex-1004, 8:42-61, Fig. 6). Sachdeva also provides clear guidance on its collision avoidance process. Ex-1007, 5:3-32, Fig. 4. Integrating it into Chishti-511 would have required no than software modifications to trigger an aligner recalculation if a collision is identified and modifying Chishti-511's "path definition process" (Ex-1004, 8:54-61) to reflect Sachdeva's movement technique as one of the options for changing tooth motion for an unacceptable aligner. This would have been well within the skill of a POSITA. Ex-1017, ¶¶58-61.

A POSITA similarly would have been motivated to combine Chishti-511 with Becker's round-tripping teachings. Ex-1003, ¶80. Chishti-511 already discusses the need for collision-free treatment paths (Ex-1004, 4:15-22), so a skilled artisan would have been motivated to look to techniques for avoiding collisions.

Ex-1003, ¶80. A POSITA would have recognized that different patients may require different treatments and thus would have been motivated to include multiple treatment methods to avoid potential collisions. *Id.* Becker provides one such teaching, illustrating how round-tripping—as specifically discussed in the '217 patent—may be used to avoid collisions in cases of patients with transposed teeth. Ex-1006, 5-7. For example, in cases involving transposed canines, a POSITA would have understood that a treatment plan may include repositioning the canines to their proper positions, and that for some patients, round-tripping may be preferable over a different treatment (e.g., extracting the tooth) because canine teeth play a critical role in preventing collapse of the dental arch. Ex-1003, ¶80.

While the treatment shown for Becker's patient is one example, a POSITA would have understood that, depending on the specifics of a patient's malocclusion, there are different ways to implement the concept of round-tripping, such as disclosed in Becker. Ex-1003, ¶81. For example, a POSITA would have understood, that after the first tooth has been moved to its previous position, the first tooth would be free to move to a different, desired final position. *Id.* Similarly, a POSITA would have also understood that if only minor tooth movement is required to avoid colliding with a second tooth, aligners alone may be used to move the first tooth out of the path of a second tooth sufficiently to avoid a collision and then moving the

first tooth back to its previous position before moving it towards its final position. *Id.* In that case, the "first tooth" may not need to move as far to be "out of the path" of the second tooth to avoid a collision. *Id.*

A POSITA also would have recognized that in other cases, where more significant tooth movement is needed to avoid a collision may utilize aligners with attachments, such as attachments shown in Becker, to achieve the desired movement. Ex-1003, ¶82. A POSITA would have understood that using attachments was well known at the time of the alleged invention. *Id.* For example, Chishti-511 describes that its process for computing the shape of an aligner will also take into account hardware attachments if necessary to create the tooth motion. *See* Ex-1004, 8:47-53 ("process 600 proceeds to execute a module that calculates the configuration of a hardware attachment to the subject tooth to which forces can be applied to effect the required motion"). Similarly, when discussing manufacturing of its aligners, Chishti-511 recognizes that this will account for "the position and selection of attachments, and the addition or removal of material (e.g., adding wires or creating dimples) to change the structure of the aligner." *Id.*, 10:1-6; *see also id.*, 6:21-24.

State-of-the-art evidence confirms that using attachments, as in Becker, with aligners was well known at the time of the alleged invention. For example, it was

known that attachments may be used with aligners to accomplish various types of movement, including labial and lingual movement, lateral movement, torque, rotation, and to adjust arch relationships. Ex-1003, ¶82; *see* Ex-1016, 26, 30-38. As one example, a button may be constructed on the aligner to which an elastic may be attached. Ex-1016, 34, 35 (Fig. 2-24c); Ex-1003, ¶82. Alternatively, a "facial window" may be cut into the clear aligner in the area where a button is bonded to the surface of a tooth, where the button serves as "the base for [an] elastic vector." Ex-1016, 37; *see also* Ex-1003, ¶82; Ex-1018, Abstract, 11:45-65; Ex-1019, Abstract, 3:21-48. Thus, a POSITA would have understood that, depending on the type of malocclusion, aligners may be used either alone or with attachments to achieve the type of round-tripping disclosed in Becker. Ex-1003, ¶82.

Although round-tripping can have disadvantages, a POSITA would have recognized that for some patients, there may be no other option other than to round-trip one or more teeth, particularly if the patient or clinician wishes to avoid extracting those teeth. Ex-1003, ¶83. Indeed, Chishti-511 expressly discloses that round-tripping is "***sometimes necessary*** to allow teeth to move past each other." Ex-1004, 4:13-15 (emphasis added). Chishti-511, Becker, and the '217 patent are thus all consistent in understanding that round-tripping—whether understood more broadly or as specifically defined in the '217 patent—may be required to treat

certain patients, even if it is, in the words of the '217 patent, "a last resort." Ex-1004, 4:9-12; Ex-1001, 13:11-17; Ex-1003, ¶83.[8]

Accordingly, a POSITA would have been motivated to include round-tripping as one feature in a system with robust software for generating treatment plans for a broad range of patients with different needs, and this would have been obvious, even if those features are only used in rare cases or as a last resort for patients that might otherwise not be able to be treated. Ex-1003, ¶83. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) ("[W]hen a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious." (quotation omitted)); *cf. Honeywell International Inc. v.*

[8] The prior art also discloses that some of the reasons clinicians tended to avoid round-tripping may have been based on only anecdotal evidence and were not supported by more rigorous research. *See* Ex-1022, 3 ("'round tripping' [has] anecdotally been stated as a cause for resorption without any hard evidence."); *id.* at 1 ("Both treatment groups exhibited the same levels of resorption indicating that the side effect of treatment may be due to individual variation and not to the 'round tripping' of teeth so often assumed."); Ex-1003, ¶70.

3G Licensing, S.A., 124 F.4th 1345, 1356 (Fed. Cir. 2025) (obviousness "does not require that a particular combination must be the preferred, or the most desirable, combination"; "[r]ather, the question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of the claimed invention.").

Moreover, a POSITA would have had a reasonable expectation of success in combining Becker's teachings for the same reasons discussed for Sachdeva. Like Sachdeva's technique, a POSITA would have been motivated to integrate Becker's round-tripping technique as an option in Chishti-511's algorithm for calculating new aligners, such as when it is determined that the aligner is unacceptable (e.g., the treatment plan results in a collision). Ex-1004, 5:25-32, 8:42-61, Fig. 6; Ex-1017, ¶62; Ex-1003, ¶84. If a collision is detected, the combined system would have Becker's technique as an option for use in Chishti-511's path redefinition process, which already incorporates other types of changes to tooth movement, to resolve the collision. Ex-1017, ¶62 Adding the option for the system to use Becker's technique to round-trip one or more teeth as part of generating a treatment plan would have involved modifying Chishti-511's software algorithm for calculating new aligners and path redefinition process (like that discussed for Sachdeva), which would have yielded predictable results and had a reasonable expectation of success.

Id.; *see Supra*. Indeed, the '217 patent specification's discussion of round-tripping includes no implementation details, indicating that including such a feature in treatment planning software was well within the skill of a POSITA. Ex-1017, ¶62; Ex-1001, 13:7-21; *see also id.*, 6:53-60, 8:21-27, 9:49-53, 10:60-64, 12:8-16, 13:51-60, 14:15-26.

If it is argued that the prior art teaches away from utilizing Becker because Chishti-511 says teeth should be moved "with the least amount of round-tripping," (Ex-1004, 4:9-11), this argument fails because the prior art discloses at least as much as the '217 patent. Chishti-511 teaches that "[r]ound tripping is sometimes necessary to allow teeth to move past each other" *Id.*, 4:13-15. This is fundamentally the same as the teaching of the '217 patent, which refers to using round-tripping as a "last resort." Ex-1001, 13:7-21; *see also* Ex-1003, ¶84.

The prior art therefore does not teach away from the combination but rather matches the "path taken by the applicant." *See Adapt Pharma Operations Ltd. v. Teva Pharms. USA, Inc.*, 25 F.4th 1354, 1370 (Fed. Cir. 2022) ("[A] reference does not teach away if a skilled artisan, upon reading the reference, would ***not*** be 'discouraged from following the path set out in the reference,' and ***would not be 'led in a direction divergent from the path that was taken by the applicant***'" (emphasis added)).

A POSITA also would have been motivated to combine Chishti-876's teachings regarding the use of movement patterns and the generation of schedules of movement with Chishti-511's treatment planning system, as such a modification would improve efficiency by allowing a technician to generate a treatment plan more quickly. Ex-1003, ¶85. Chishti-511 already discloses the importance of tailoring the generated treatment plan to a clinician's preferences and proposing treatment plans for a clinician's approval, and the use of predetermined movement patterns would facilitate interactions with a clinician by providing repeatable, known treatment techniques. *See, e.g.*, Ex-1004, 3:59-64 (discussing receiving prescription and constraints from clinicians and allowing clinician interaction through a client), 2:45-53, 4:36-50. A POSITA would have understood that such a modification would improve efficiency by allowing a technician to generate a treatment plan more quickly and with potentially fewer modifications, improve treatment quality by applying treatment techniques that had been used successfully for similar patients, implement clinician preferences, and improve flexibility by providing multiple treatments appropriate for patients' needs. Ex-1003, ¶85.

A POSITA also would have had a reasonable expectation of success in combining Chishti-876's pattern features with Chishti-511's system, as both disclose similar computer-implemented systems for patient treatment planning. Ex-

1017, ¶63 (citing Ex-1004, 2:45-53; Ex-1005, 15:1-3, 16:57-17:12). Indeed, Chishti-876 and Chishti-511 have common inventors and overlapping details, so a POSITA would have expected that both disclosed systems teach compatible interactive treatment planning tools and software that may readily be combined in a single system. *Id.*

Chishti-876 discloses a database of treatment patterns that can be selected, and a POSITA would have recognized this feature is equally applicable to Chishti-511's system. Ex-1017, ¶¶64-65 (citing Ex-1005, 14:63-15:1). Integrating this feature into Chishti-511 would allow selection from a plurality of treatment patterns that would affect the schedule of teeth movement, just as in Chishti-876. *Id.* And such a combination would have required only standard, well-known software development techniques that would have yielded predictable results, especially because Chishti-876 itself provides flow charts for calculating movement paths based on patterns, such as the known all equal, A shape, or V shape patterns, which a POSITA would have been able to look to when integrating these features. Ex-1017, ¶65 (citing Ex-1005, Figs. 14, 15, 18, 20A, 20B, 18:1-18:23, 19:15-38, 20:4-60). And Chishti-876 similarly provides significant information regarding how the defined schedule of movement is used and represented in software. *See* Ex-1017, ¶¶74-76 (citing Ex-1005, 9:13-20, 10:29-34, 11:38-43, Figs. 10-13).

Finally, for the various features of Chishti-876, Sachdeva, and Becker discussed in this Petition to be combined with Chishti-511, those features would not have interfered with one another when combined with Chishti-511's system. Ex-1003, ¶86; Ex-1017 ¶79.

IX. CHISHTI-511 IN VIEW OF CHISHTI-876, SACHDEVA, AND BECKER RENDERS OBVIOUS CLAIMS 1-20

A. Independent Claim 1

1. [1(pre)] A method comprising:

To the extent the preamble is limiting, Chishti-511 discloses a "method[]" for orthodontic treatment planning. Ex-1004, Abstract ("segmenting an orthodontic treatment path into clinically appropriate substeps for repositioning the teeth of a patient"); *see also* Ex-1004, 1:33-39, 2:34-39; Ex-1003, ¶91.

2. [1(a)] selecting a movement pattern from a plurality of movement patterns for moving dental objects from an initial arrangement toward a final arrangement, the dental objects being based on output of a scanning device, the movement pattern defining a schedule of movement of the dental objects during treatment stages as each of the dental objects moves from a respective initial position toward a respective final position;

Chishti-511 in view of Chishti-876 renders obvious this limitation. Ex-1003, ¶¶92-97.

Chishti-511 discloses a schedule of movement of the dental objects during treatment stages as each of the dental objects moves from a respective initial

position toward a respective final position. In this schedule of movement, Chishti-511 bases the dental objects on "output of a scanning device," as Chishti-511 gathers data by acquiring "a mold ***or a scan*** of [a] patient's teeth" to create "a digital data set" representative of the initial arrangement of dental objects. Ex-1004, 3:40-50 (emphasis added); *see also* Ex-1004, 3:51-58; Ex-1003, ¶92.

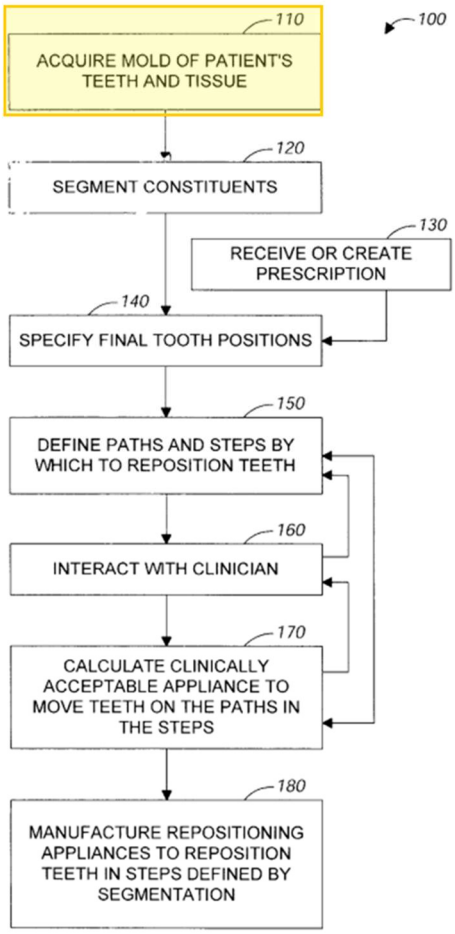


FIG. 1

Ex-1004, Fig. 1 (annotated). The system then receives the "desired final position of the teeth," which may be "calculated from basic orthodontic principles" or

"extrapolated computationally from a clinical prescription" or received from a clinician. Ex-1004, 3:59-4:6. Next, the process "defines a tooth path for the motion of each tooth" from initial to final positions. Ex-1004, 2:59-67, 3:41-50, 4:7-22; Ex-1003, ¶¶92-93.

To achieve this, "[t]he tooth paths are segmented," and optimized "to bring the teeth from their initial positions to their desired final positions." Ex-1004, 4:7-22. Appliance configurations are then calculated based on the segmented tooth paths, where each appliance "represents a step along the treatment path." Ex-1004, 4:51-67; Ex-1003, ¶94.

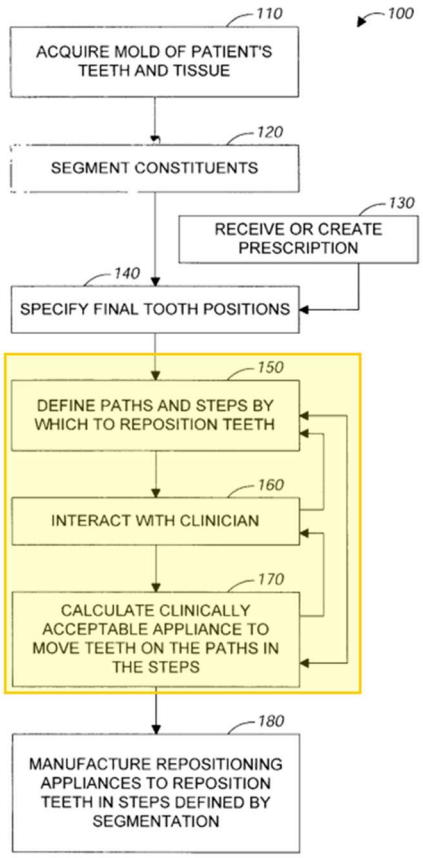


FIG. 1

Ex-1004, Fig. 1 (annotated). Thus, Chishti-511 discloses "a schedule of movement of the dental objects during treatment stages as each of the dental objects moves from a respective initial position toward a respective final position," as claimed. Ex-1003, ¶94.

While Chishti-511 does not expressly provide selecting a movement pattern from a plurality of movement patterns for moving dental objects from an initial arrangement toward a final arrangement, Chishti-876 does and renders obvious this feature. *See* Section VIII; Ex-1003, ¶95. The '217 patent admits that Chishti-876

disclosed movement patterns. Ex-1001, 6:8-14. Chishti-876 explains that its algorithm draws upon a library of predetermined tooth-treatment patterns, and its system allows for the selection of "one teeth treatment pattern from a plurality of predetermined teeth treatment patterns." Ex-1005, Abstract, 2:63-3:5, 3:24-33. Each treatment pattern presents a "transformation curve" applied to each tooth in order "to move th[at] tooth from its initial position to its final position." Ex-1005, 12:38-43.

Chishti-876 explains that its system "generat[es] the malocclusion treatment plan in accordance with the selected treatment pattern." Ex-1005 2:63-3:5, 2:20-24. Chishti-876 provides several exemplary movement patterns, including disclosing how the schedule of movement will be generated based on the selected pattern. Ex-1005, 2:44-62, 3:6-10, 3:24-27, 3:38-40, 3:49-51, 16:48-17:17, Figs. 10-13; Ex-1003, ¶95. Using these patterns, Chishti-876 explains that it will "define or map the movement of selected individual teeth from the initial position to the final position over a series of successive steps." Ex-1005, 9:13-19; *see also* Ex-1005, 7:13-19, 9:33-45, 10:12-17, 11:32-65, Fig. 3; Ex-1003, ¶96.

As shown below, Chishti-876's movement schedule shows for each treatment stage when each tooth is moving (annotated green for the leftmost tooth) or not moving (annotated red for the leftmost tooth):

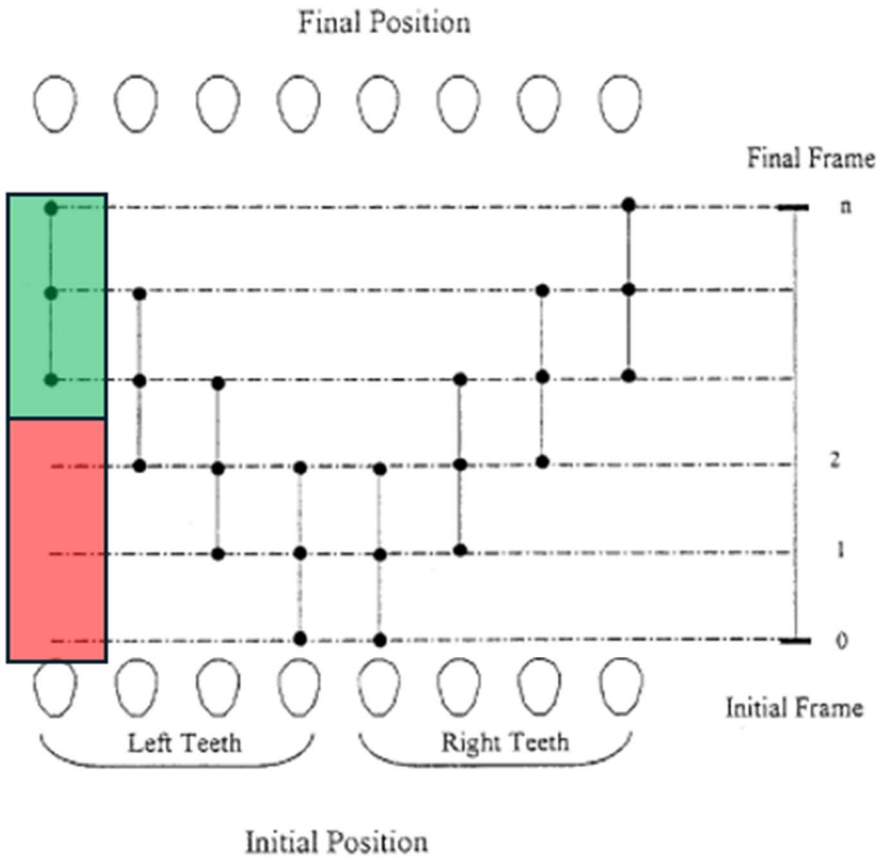


FIG. 11

Ex-1005, Fig. 11 (annotated), 17:1-7; Ex-1003, ¶97. Thus, Chishti-876's movement pattern defines a schedule of movement of the dental objects during treatment stages as each of the dental objects moves from a respective initial position toward a respective final position. Ex-1003, ¶97.

3. [1(b)] calculating, by a computer processor, a respective treatment path for each of the dental objects between its respective initial and final positions;

Chishti-511 discloses this feature. In particular, Chishti-511 teaches that its computer program (Ex-1004, 2:34-39, 3:31-39, 10:19-51) "defines a tooth path" (calculates a respective treatment path) "for the motion of each tooth" (for each dental object), which includes "bring[ing] the teeth from their initial positions to their desired final positions" (between their respective initial and final positions). Ex-1004, 4:7-22; *see also id.*, 4:51-67 (the segmented tooth paths "are used to calculate clinically acceptable appliance configurations" that "will move the teeth on the defined treatment path in the steps specified by the path segments"). Chishti-511's system further incorporates "a path definition module that calculates the paths taken by teeth as they are repositioned during treatment." Ex-1004, 1:62-67; Ex-1003, ¶¶98-99.

As Chishti-511 explains, the steps of the method may be performed on a computer by a computer processor.[9] Ex-1004, 2:34-39, 3:31-39, 10:19-51

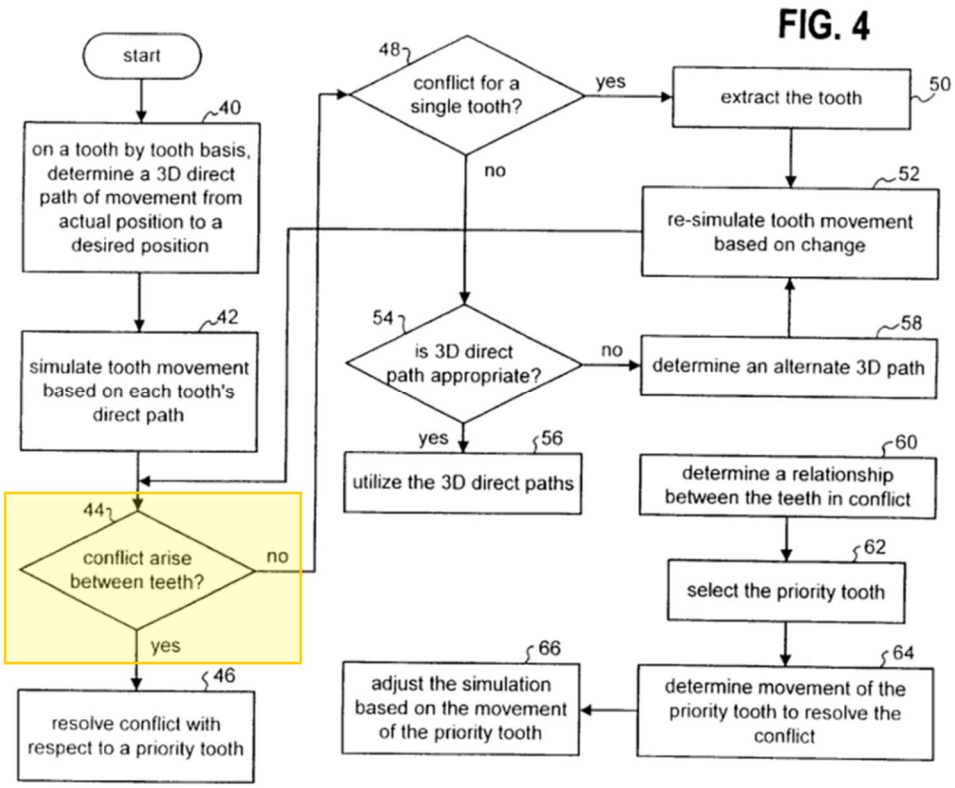
[9] This applies equally to all remaining claim limitations that recite steps performed "by a computer processor."

(explaining that the steps of the process may be implemented on a computer program, including for execution by a programmable processor); Ex-1003, ¶99.

4. [1(c)] identifying, by a computer processor, a collision between a first of the dental objects and a second of the dental objects based at least on one of the respective treatment paths; and

Chishti-511 discloses this limitation and renders it obvious both alone and in view of Sachdeva. Ex-1003, ¶100. Chishti-511's solution seeks a "clinically viable sequence of tooth positions" that "do[] not result in a collision of teeth." Ex-1004, 4:7-22. Chishti-511 further states that new aligners will be calculated if the system determines teeth motion is not "orthodontically acceptable" or if "an acceptable end position is not reached by the teeth." Ex-1004, 5:25-32. A POSITA would have understood that a schedule of movement resulting in a collision would be orthodontically unacceptable and unlikely to reach an acceptable end position. Ex-1003, ¶100. Chishti-511 further teaches that, when aligners are unacceptable, "the process transfers control to a path definition process" "to redefine those parts of the treatment path having unacceptable aligners." Ex-1004, 8:42-61. Thus, during Chishti-511's treatment planning process, the system identifies unacceptable movements, including those resulting in a collision based on teeth paths, so that the schedule of movement may be redefined. Ex-1003, ¶100.

A POSITA also would have been motivated to modify Chishti-511 to include Sachdeva's automated collision-identification teachings. *See* Section VIII; Ex-1003, ¶101. During Sachdeva's treatment planning process, the computer "simulates tooth movement based on each tooth's path" and automatically determines if "a conflict in movement arose between at least two teeth." Ex-1007, 5:3-8, Fig. 4; Ex-1003, ¶101.



Ex-1007, Fig. 4 (annotated).

Sachdeva explains that a conflict may arise if the "movement of one tooth interferes with the direct path of another tooth" (i.e., a collision), "causing a

particular tooth to not be able to reach its desired position." Ex-1007, 5:3-8. Thus, Sachdeva discloses its system identifying a collision between a first of the dental objects and a second of the dental objects based at least on one of the respective treatment paths. Ex-1003, ¶102.

Sachdeva explains that its process may be performed on a computer by a computer processor.[10] Ex-1007, 3:34-50, 4:39-49; Ex-1003, ¶102.

5. [1(d)] performing, by a computer processor, a first modification of the schedule of movement in response to the identifying, the first modification comprising:

Chishti-511 discloses this feature and renders it obvious both alone and in view of Sachdeva. Ex-1003, ¶¶103-109. Chishti discloses that, when aligners are unacceptable, "the process transfers control to a path definition process" "to redefine those parts of the treatment path having unacceptable aligners." Ex-1004, 8:42-61; *see also id.*, 4:7-50, 5:7-32, Figs. 1, 2, 4, 6; Ex-1003, ¶¶103-105 (citing Ex-1004, 6:63-7:8, 8:29-9:2). A POSITA would have understood this is performed in response to identifying a collision, as Chishti-511 discloses seeking a "clinically viable sequence of tooth positions" that "does not result in a collision of teeth." Ex-

[10] This applies equally to all remaining claim limitations that recite steps performed "by a computer processor."

1004, 4:7-22; *see also id.*, 8:42-9:14 (disclosing "[a]ligners may be unacceptable for a variety of reasons"), 5:7-32; *see also* Section IX.A.4; Ex-1003, ¶106.

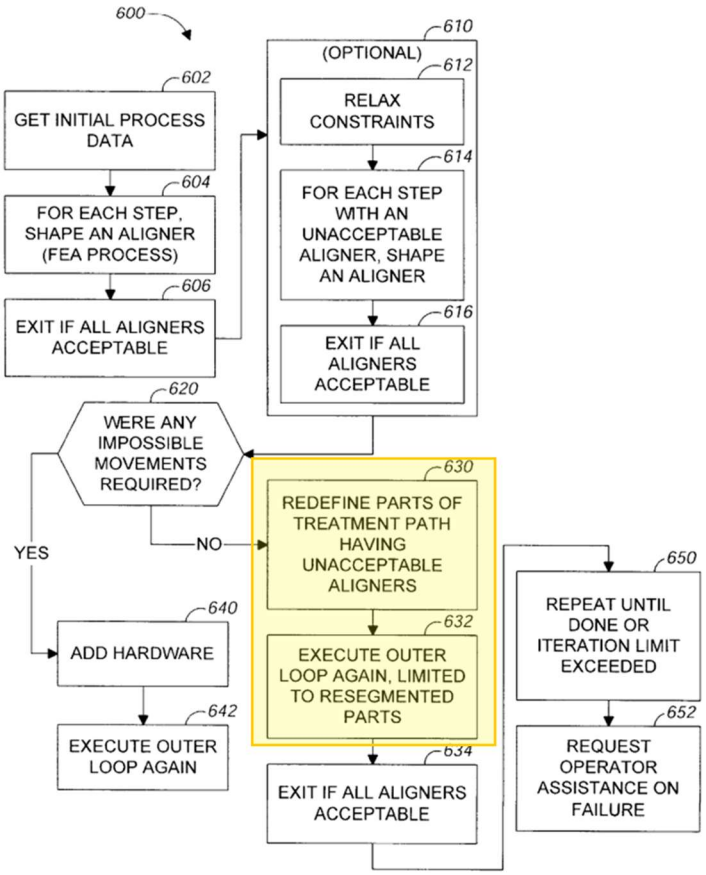


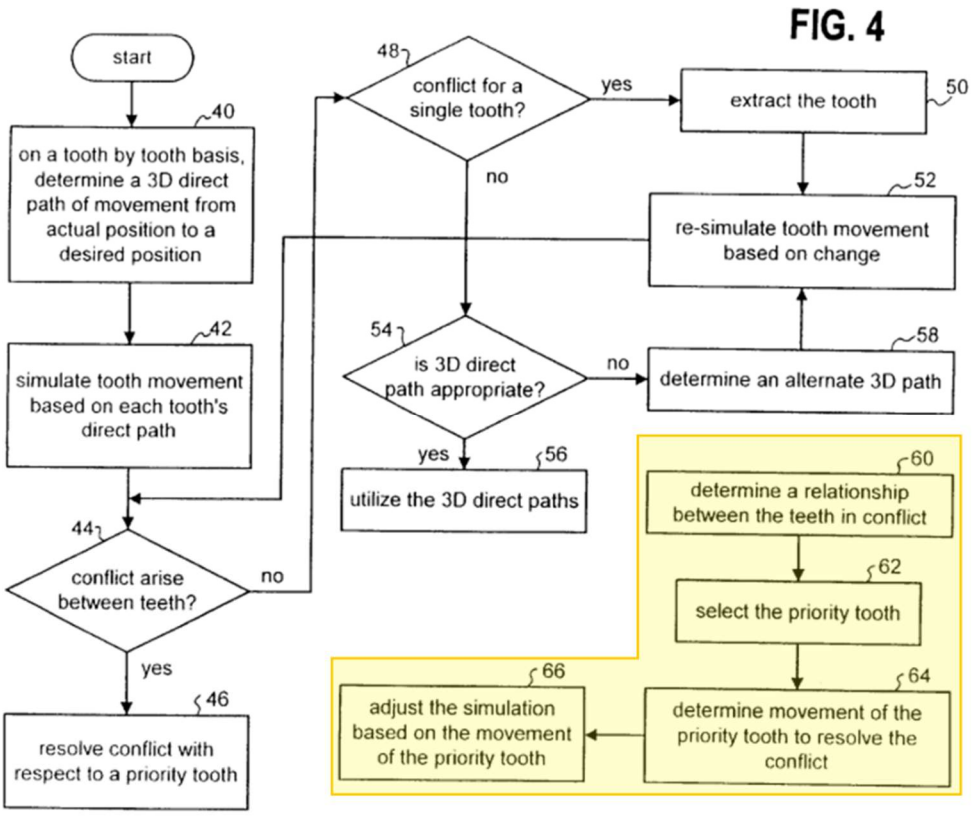
FIG. 6

Ex-1004, Fig. 6 (annotated). Thus, this path redefinition will be performed "in response to the identifying" of a collision. Ex-1003, ¶106.

If the processor identifies a collision, the path redefinition process will perform "a first modification of the schedule of movement," as Chishti-511 explains that its modifications include "changing the increments of tooth motion, i.e., changing the segmentation, on the treatment path, changing the path followed by

one or more teeth in the treatment path, or both." Ex-1004, 8:54-61; *see also id.*, Figs. 4, 6; Ex-1003, ¶106.

If it is argued that Chishti-511 does not expressly disclose modifying the schedule of movement in response to "identifying a collision," Sachdeva does. Ex-1003, ¶107. As discussed for limitation 1(c), Sachdeva describes automatically identifying a collision. *See* Section IX.A.4. Sachdeva further explains that, "[i]f a conflict arose" (i.e., in response to the identifying), the system will automatically change the "movement of the priority tooth to resolve the conflict" (performing a first modification of the schedule of movement). Ex-1007, Fig. 4; *see also id.*, 5:9-36 (discussing delaying a tooth in response to identifying a collision); *see also* Section IX.J.2 (claim 10(b), discussing Sachdeva's delaying modification); Ex-1003, ¶108.



Ex-1007, Fig. 4 (annotated); Ex-1003, ¶108. A POSITA would have been motivated to modify Chishti-511 to include Sachdeva's automated collision-identification and avoidance teachings. Ex-1003, ¶107. *See* Section VIII.

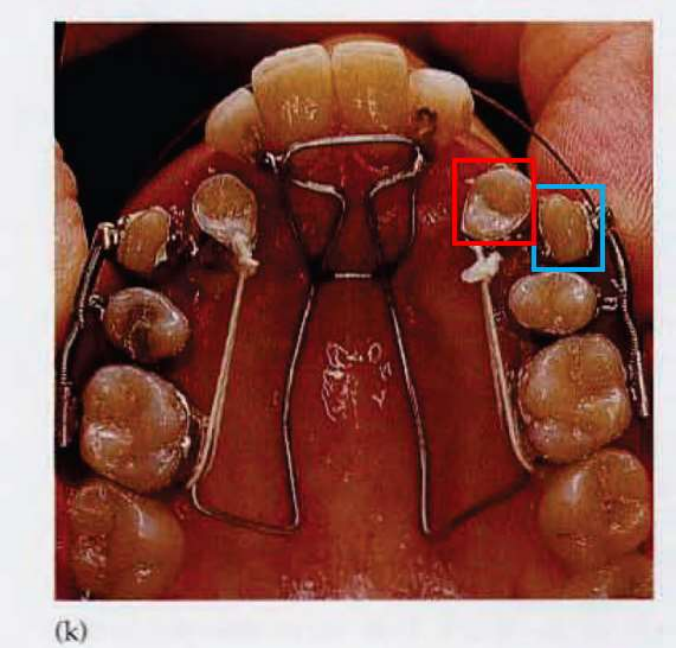
Thus, this feature also would have been obvious based on Chishti-511 alone, and based on Chishti-511 in view of Sachdeva. Ex-1003, ¶109.

6. [1(e)] round-tripping the first dental object.

Chishti-511 in view of Becker renders this limitation obvious. The parties have agreed that "round-tripping" means "moving a first tooth out of the path of a second tooth, and once the second tooth has moved sufficiently, moving the first

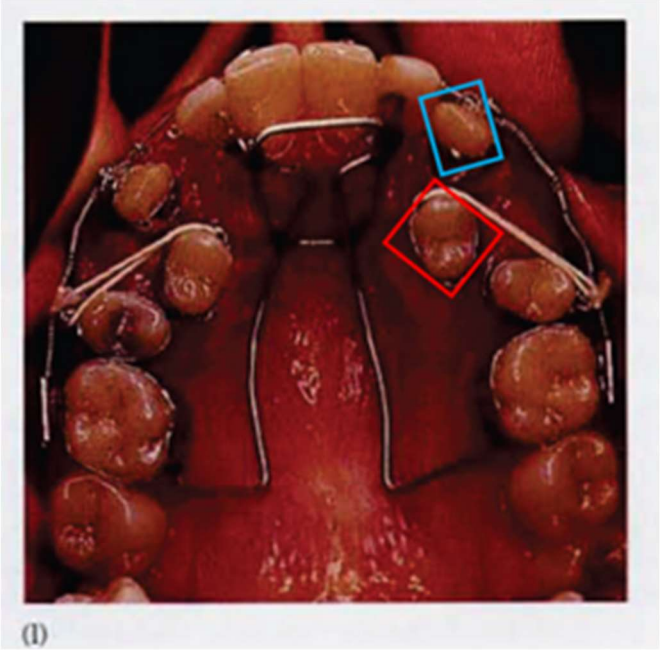
tooth back to its previous position before proceeding to a desired final position of that first tooth." Ex-1013, 8. For the same reasons discussed in Section VIII, a POSITA would have been motivated to modify the combined system to implement Becker's round-tripping collision avoidance. Ex-1003, ¶110.

Becker discloses using the claimed round-tripping modification to avoid a collision. Ex-1003, ¶¶111-113. Becker presents a malocclusion in which a more lingual tooth ("first tooth," red) is transposed with a more buccal tooth ("second tooth," blue)—such that the more buccal tooth needs to be moved toward the incisors and the midline of the mouth. Ex-1006, 5; Ex-1003, ¶113.



Ex-1006, 7 (Fig. 8.6(k) (annotated)).

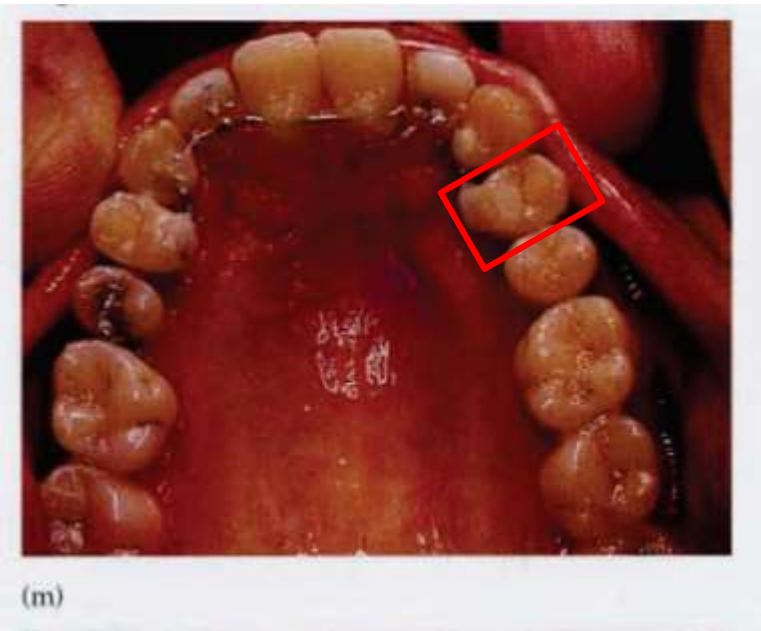
As shown in Figure 8.6(k) above, moving the more buccal tooth to its proper position would cause a collision between the two teeth. Ex-1003, ¶114. To resolve the transposition, Becker discloses "slid[ing] the more buccal of the transposed teeth" (i.e., the tooth closer to the cheek) "in the medio-distal plane" (i.e., toward the midline or center of the dental arch). Ex-1006, 5. To allow this movement, Becker discloses that "the more lingual of the transposed teeth" "must be moved further lingually to allow its partner to pass by" (*id.*) ("moving a first tooth out of the path of a second tooth"). Figure 8.6(l) below depicts the more lingual tooth after it has moved lingually and allowed the more buccal tooth to pass by. Ex-1006, 5; Ex-1003, ¶114.



Ex-1006, 7 (Fig. 8.6(l) (annotated)).

After the more lingual tooth is moved lingually "to allow its partner [the more buccal tooth] to pass by," the more lingual tooth moves back to its previous position before proceeding to a desired final position of that first tooth. Ex-1006, 5; Ex-1003, ¶115. Once the more buccal tooth has "moved sufficiently," Becker explains that the more lingual tooth "must be moved in the opposite mesio-distal direction and back in the line of the arch." Ex-1006, 5. A POSITA would have understood that moving the more lingual tooth in the "opposite" direction that it previously moved and "back" to where it was before ("in line of the arch") (*id.*) would move the more lingual tooth "back to its previous position." Ex-1003, ¶115.

A POSITA would have understood, however, that the more lingual tooth's previous position is not its final position, and that further movement is necessary. Ex-1003, ¶116; Ex-1006, 5. Indeed, Figure 8.6(m) below shows the more lingual tooth after it proceeds to its desired final position.



Ex-1003, ¶116 (annotating Ex-1006, 8 (Fig. 8.6(m))).

Such a subsequent movement to a final position also would have been obvious to a POSITA, who would have understood that multiple small adjustments are often necessary to achieve a final satisfactory arrangement of teeth (e.g., removing all gaps, precise alignment with other teeth). Ex-1003, ¶117. It is also consistent with Sachdeva. Sachdeva explains that its conflict resolution seeks to "move[] a tooth sufficiently to resolve the conflict," (Ex-1007, 5:27-30) which would allow a previously blocked tooth to achieve its desired position. Ex-1003, ¶117. After a conflict is resolved, "the simulation is adjusted based on the movement of the priority tooth." Ex-1007, 5:30-32. A POSITA would have recognized that subsequent simulation may cause further movement of the

previously blocked tooth toward its final position, and thus Sachdeva similarly recognizes that a treatment plan may include moving the first tooth more after resolving the conflict. Ex-1003, ¶¶117-118.

B. Claim 2: The method of claim 1, wherein the movement pattern is selected by a user.

Chishti-876 renders this limitation. Chishti-876 explains that its process "allows a user to select one move pattern from a plurality of move patterns" to complete the desired dental repositioning. Ex-1005, 17:17-19; *see also* Ex-1005, 17:65-67 (disclosing that "process depend[s] on the move pattern that is ***specified by the user***." (emphasis added)). Ex-1003, ¶¶119-120.

C. Claim 3: The method of claim 1, wherein the selecting comprises analyzing, by a computer processor, the dental objects in their respective initial and final positions.

Chishti-511 alone or in view of Chishti-876 renders this limitation obvious. Ex-1003, ¶¶121-126. Chishti-511 explains that after "[h]aving both a beginning position and a final position for each tooth, the process defines a tooth path for the motion of each tooth." Ex-1004, 4:7-22. These initial and final tooth positions are analyzed by the system to "optimize[]" the tooth paths "so that the teeth are moved in the quickest fashion … to bring the teeth from their initial positions to their desired final positions." *Id.* A POSITA would have understood that, while creating

the acceptable tooth paths, the system analyzes the dental objects in their respective initial positions and respective final positions. Ex-1003, ¶¶121-122.

If it is argued that Chishti-511 does not disclose this limitation, it would have been obvious in view of Chishti-876. Ex-1003, ¶¶123-126. Chishti-876 teaches that when selecting a movement pattern, its system "takes into consideration the following: 1. ***Initial Position***: a detailed description of the initial maloclussion [sic]," and "2. ***Final Position***: a detailed description of treatment goals for the patient." Ex-1005, 9:34-67 (emphasis added). Indeed, Chishti-876 explains that its "program receives as input the initial and final positions of the patient's teeth and uses this information to select intermediate positions for each tooth to be moved." Ex-1005, 13:27-30. Thus, Chishti-876's selecting includes analyzing the dental objects in their respective initial and final positions. Ex-1003, ¶¶123-126. Chishti-876 discloses a computer processor for executing instructions to perform its steps.[11] *See* Ex-1005, 13:23-48, 23:7-32; Ex-1003, ¶126.

A POSITA would have been motivated to analyze the dental objects in their initial and final positions because this data would assist in analyzing whether the

[11] This applies equally to all remaining claim limitations that recite steps performed "by a computer processor."

dental objects started and ended in their correct locations and to identify whether the generated paths had been "optimized" as taught by Chishti-511. Ex-1003, ¶126. A POSITA also would have had a reasonable expectation of success in combining Chishti-511 and Chishti-876 because it would involve a mere software modification. Ex-1017, ¶78. And because Chishti-511 already has access to the initial and final positions, as used in Chishti-876, the modification would merely involve analyzing those parameters when determining tooth paths to ensure that the teeth travel from the initial to final positions. Ex-1017, ¶¶77-78; Ex-1003, ¶126.

D. Claim 4: The method of claim 3, wherein the analyzing comprises determining, by a computer processor, a respective distance needed to move each of the dental objects from its respective initial position to its respective final position.

Chishti-876 discloses this feature. The '217 patent admits that "the computer program can suitably calculate distances between a first tooth and a second tooth and then apply geometrical techniques, such as those disclosed in [Chishti-876]." Ex-1001, 6:45-52; Ex-1003, ¶127.

Chishti-876 discloses "determining [that] a tooth path comprises finding a collision-free shortest path between an initial position and a final position for one or more teeth." Ex-1005, claim 3; *see also* Fig. 7, 14:25-40. A POSITA would have understood that determining a "shortest" path would include determining a distance between an initial position and final position to determine which collision-free path

is shortest. Ex-1003, ¶127. Chishti-876 also discloses with its X-type or "all equal" movement pattern, the system determines the schedule of movement by first analyzing, for each tooth, a beginning frame and ending frame, and determining if the movement from the beginning frame to the mid frame is too large (i.e., the first half of the distance) and determining whether the movement from the mid frame to the end frame is too large (i.e., the second half of the distance). Ex-1005, 16:57-67, 18:1-42, Figs. 15-16. A POSITA would recognize that, together these values constitute the "respective distance needed to move each of the dental objects from its respective initial position to its respective final position" which is determined and analyzed by Chishti-876. Ex-1003, ¶¶127-129.

If it is argued that the claimed distance is not determined, it would have been obvious to do so to ensure that the shortest path is achieved. Ex-1005, claim 3; *see also* Fig. 7, 14:25-40. A POSITA would have been motivated to combine such a calculation with Chishti-511's system to improve patient results by allowing it to determine which paths have shorter distances and to avoid the use of paths that may violate safe movement limits, especially because Chishti-511 expresses a desire to move teeth "in the quickest fashion." Ex-1003, ¶130. A POSITA would have had a reasonable expectation of success in such a combination because Chishti-511's system already includes the necessary information (e.g., initial and final positions,

tooth paths, and segments) (Ex-1004, 4:7-22), and such a change would involve a mere software modification of using that existing data to calculate the distance of each tooth segment, as the teeth move from initial to final positions. Ex-1017, ¶¶66-69.

E. Claim 5

1. [5(a)] The method of claim 1, further comprising: determining, by a computer processor, that the first modification does not avoid a collision between the first and second dental objects; and

Chishti-511 discloses this feature and renders it obvious both alone and in view of Sachdeva. Ex-1003, ¶¶131-136. As explained for limitations 1(c)-1(d), the combined system will identify a collision between dental objects and perform a modification to avoid the collision. *Supra* Sections IX.A.4-5.

Chishti-511 further details that "[a]fter the treatment path has been redefined" due to unacceptable aligners, "the outer loop of the overall process is executed again (step 632)" for the redefined aligners. Ex-1004, 8:61-9:2, Fig. 6. Moreover, "the overall process can be repeated until an acceptable set of aligners is found or an iteration limit is exceeded." *Id.* Thus, Chishti-511 discloses an iterative process that continues to evaluate its planned treatment until it attains an acceptable treatment path without collisions.

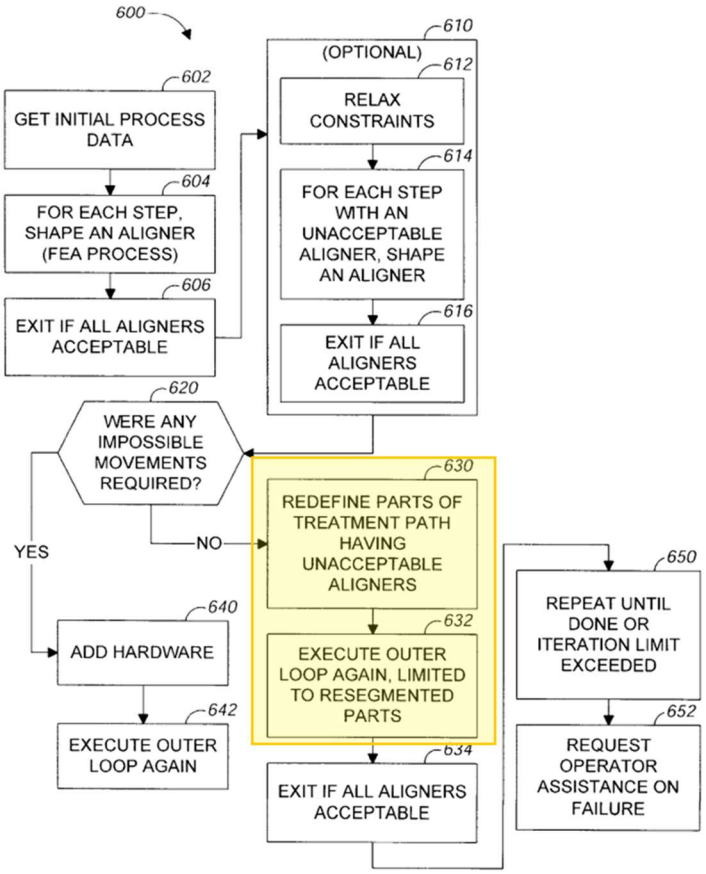


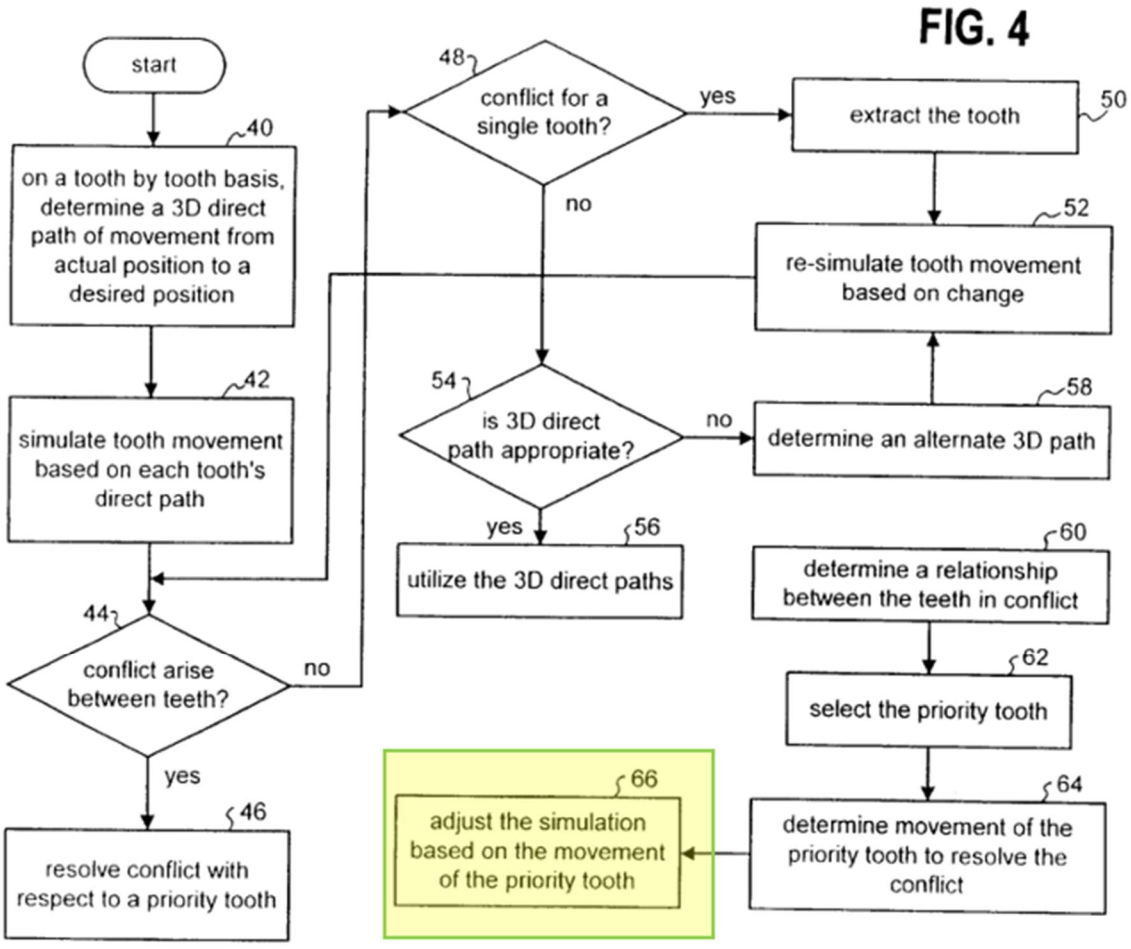
FIG. 6

Ex-1004, Fig. 6 (annotated); Ex-1003, ¶¶132-133.

Thus, the same steps of the combined system discussed in limitations 1(c)-1(d) will be iteratively performed to determine whether the aligners are acceptable. *Supra* Sections IX.A.4-.5. Because Chishti-511 (in view of Sachdeva) continues to check if the aligners are acceptable as the process loops, a POSITA would have understood that its process determines whether the first modification (i.e., round-tripping as in Becker) successfully avoided the collision between the first and second dental objects, including determining if the modification did not avoid a

collision. Ex-1004, 4:18-22, 4:51-56, 5:25-43, 8:29-35, Figs. 1, 2, 4, 6; Ex-1003, ¶134.

This understanding of the combined system is also consistent with Sachdeva, which discloses that "the simulation is adjusted based on the movement" previously performed to avoid a collision. Ex-1007, 5:29-32; *see also* Ex-1007, Fig. 4:



Id., Fig. 4 (annotated). Thus, like Chishti-511, Sachdeva will continue simulating results to detect additional potential collisions. Ex-1003, ¶135.

Chishti-876 likewise discloses that it "alters the path" when detecting a collision and the "program then samples the new path (1604) and again applies the collision detection algorithm (1606)." Ex-1005, 13:38-48. It explains that "[t]he program continues in this manner until no collisions are detected." *Id.*

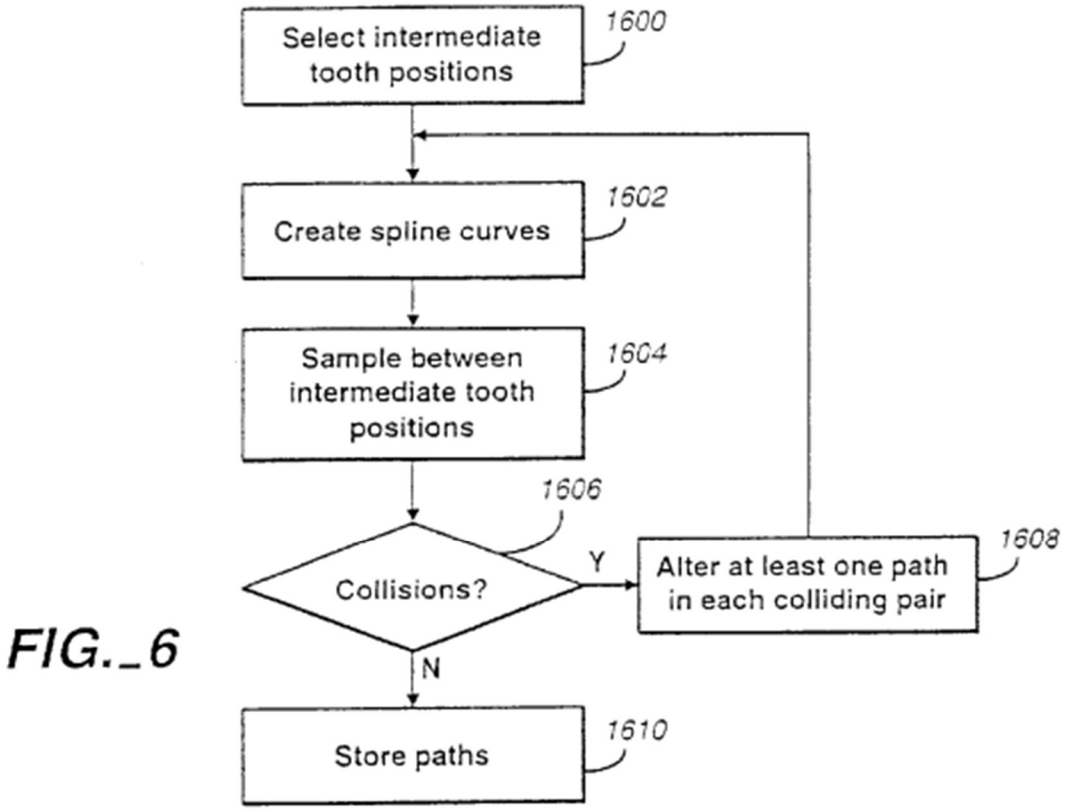


FIG._6

Id., Fig. 6. Thus, this feature was well known and would have been obvious in view of the combined system. Ex-1003, ¶136.

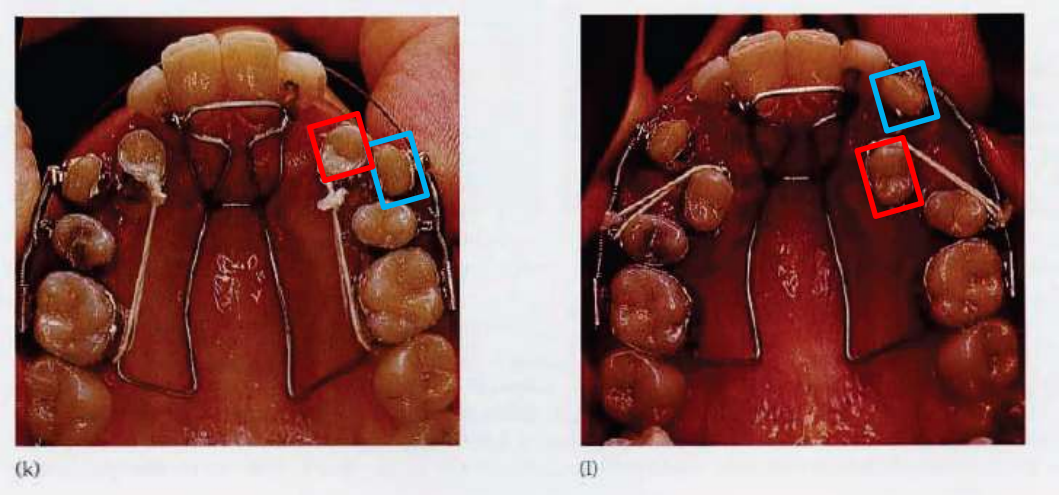
2. [5(b)] performing, by a computer processor after the determining, a second modification of the schedule of movement, the second modification comprising slowing or stopping movement of the first dental object during one or more of the treatment stages following a previous one of the treatment stages in which the first dental object moved.

Chishti-511 in view of Becker and Chishti-876 renders this limitation obvious. As explained above for limitation 5(a), Chishti-511 details an iterative process. Therefore, similar to the combination's teaching of limitation 1(d), the combination likewise teaches performing a second modification "to redefine those parts of the treatment path [still] having unacceptable aligners." Ex-1004, 8:54-9:14; Ex-1003, ¶¶92-97, 131-137; *supra* Sections IX.A.5 (1(d)), IX.E.1 (5(a)). Indeed, as discussed, the system "repeat[s] until an acceptable set of aligners is found or an iteration limit is exceeded." Ex-1004, 8:54-9:14. Thus, Chishti-511's path definition process will be repeated and those unacceptable portions of the treatment path will be redefined if the first modification did not avoid a collision. Ex 1004, 8:54-9:14, Fig. 6; Ex-1003, ¶137.

While Chishti-511 seeks to avoid collisions, it leaves open how to alter tooth movement to avoid collisions that are detected. Ex-1003, ¶138. Chishti-876 discloses one such movement alteration method of slowing a tooth's movement during treatment stages. Ex-1005, 12:25-31 (explaining one tooth "may accelerate"

in certain stages while another tooth first "moves linearly" and then "changes direction suddenly and slows down along a linear path to a later stage (e.g., stage 10)."). Thus, in Chishti-876, one tooth is "scheduled to move at a rate less than the rate of other teeth" as the other tooth accelerates and the slower tooth "slows down" even further relative to the other described tooth so that a collision does not occur, consistent with the parties' agreed-upon construction for slowing. *See* Section V; Ex-1005, 12:25-31; Ex-1003, ¶138. Further, the tooth slows "during one or more of the treatment stages following a previous one of the treatment stages in which the first dental object moved," consistent with the claim. Ex-1003, ¶138.

As described above, Becker's technique involves moving a tooth (the more lingual tooth) to allow another tooth (the more buccal tooth) "to pass by." Ex-1006, 5.



See also Ex-1006, 7 (Figs. 8.6(k), (l) (annotated)). A POSITA would recognize that after the more lingual tooth was moved lingually ("following a previous one of the treatment stages in which the first dental object moved"), it would be stationary or stopped for some time to allow the more buccal tooth to "pass by." Ex-1003, ¶¶139-140.

A first iterative modification using Chishti-511's system may find that the more lingual tooth was not stopped long enough for the more buccal tooth to "pass by," and a collision may still result. *Id.* A POSITA would have found it obvious for the same reasons discussed above and for claim 1 to further modify the parameters associated with using Becker's treatment ("a second modification of the schedule of movement"), such as increasing the number of treatment stages during which the more lingual tooth is stopped, to ensure that the more buccal tooth can "pass by" as directed by Becker ("stopping movement of the first dental object during one or more of the treatment stages following a previous one of the treatment stages in which the first dental object moved"). *Id.* A second modification as described would help ensure that a collision is avoided. *Id.*

Chishti-876 likewise solves this problem. Ex-1003, ¶141. Chishti-876 explains that incrementally moving a dental object an equal distance towards its final position may not always be satisfactory. Ex-1005, 12:6-21, 13:23-48. Instead,

alterations of the movements may be necessary. *Id.* For instance, sometimes the dental objects may need to move towards an intermediate position (using key frames) before ***slowing*** along the movement path. (Ex-1005, 12:22-32); Ex-1003, ¶142. Chishti-876 recognizes that each dental object may move independently (e.g., one moving at one rate, and another moving at a slower rate). Ex-1005, 3:24-33, 12:22-32; Ex-1003, ¶143.

As discussed above, a POSITA would understand that Becker's technique may still result in a collision if the more buccal tooth is not given sufficient time to "pass by" before the more lingual tooth is moved to its previous and final positions. Ex-1003, ¶¶142-144. As an alternative to the more lingual tooth remaining stationary for longer, a POSITA would have been motivated to implement Chishti-876's teaching of slowing a dental object. Slowing the more lingual tooth after it is moved out of the path of the more buccal tooth so that it is scheduled to move at a rate less than the rate of the more buccal tooth would provide more time for the more buccal tooth to "pass by" before the more lingual tooth moves to its previous position. *Id.* Thus, it would have been obvious to have "one or more teeth scheduled to move at a rate less than the rate of other teeth, … so that collisions and/or obstructions do not occur." *Id.*

A POSITA would been motivated to combine Chishti-876's slowing technique with Chishti-511 and would have found this to be beneficial because, if the rate of movement of the more lingual tooth was slowed, it may move toward its previous and final positions sooner (rather than keeping the more lingual tooth stationary for longer) while still avoiding a collision, potentially leading to faster overall treatment. Ex-1003, ¶145. A POSITA would have been motivated to complete treatment soonest given Chishti-511's express desire to move teeth to final positions in the quickest fashion. *Id.*; Ex-1004, 4:7-12. The round-tripped tooth would also potentially be out of position for less time, which would increase the chances of successful treatment. Ex-1003, ¶145. Thus, it would have been obvious to use Chishti-876's slowing feature as a "second modification" to the schedule of movement. *Id.*

A POSITA would have had a reasonable expectation of success in modifying Chishti-511 to include stopping or slowing, as this would be a mere software modification. Chishti-511 already discloses that each of its segments includes an "end point." Ex-1017, ¶¶70-71 (citing Ex-1004, 4:15-22). A POSITA would recognize that implementing slowing or stopping would merely involve a slowed tooth traveling a lesser (or zero) distance to the next "end point" in slowed segments

relative to non-slowed teeth. *Id.* This would have been well within the skill of a POSITA at the relevant time. *Id.*

F. Claim 6

1. [6(a)] The method of claim 5, further comprising: determining, by a computer processor, that the second modification does not avoid a collision between the first and second dental objects; and

Chishti-511 discloses this feature and renders it obvious both alone and in view of Sachdeva for the same reasons discussed for limitation 5(a). *Supra* Section IX.E.1; Ex-1003, ¶147. As discussed, because Chishti-511 and Sachdeva use an iterative process, the combination will determine after each modification if any orthodontically unacceptable movements, such as collisions, will occur (including whether the modification does not avoid a collision). *Id.*

2. [6(b)] performing, by a computer processor after determining that the second modification does not avoid a collision, a third modification of the schedule of movement, the third modification comprising round-tripping the first dental object.

Chishti-511 in view of Sachdeva and Becker renders this limitation obvious. As discussed for limitation 5(a), Chishti-511 alone and in view of Sachdeva iteratively performs modifications and redefines the schedule of movement until an acceptable set of aligners is found. Ex-1004, 8:54-9:14, Fig. 6; Ex-1003, ¶148; *see* Section IX.E.1. Accordingly, a POSITA would have understood that if a second

modification did not resolve the collision between teeth, a third modification would be performed. Using round-tripping as a modification (as disclosed in Becker) would have been obvious for the same reasons discussed above in limitation 1(e). *Supra* Section IX.A.6; Ex-1003, ¶148.

A POSITA would have understood that a collision may still be present after a second modification (slowing or stopping) is performed for a variety of reasons. For example, this could occur (1) if the second tooth begins moving too quickly before the first tooth has had time to "pass by;" (2) if the first tooth did not move far enough away or did not move away quickly enough; or (3) if a second tooth began moving too soon or too quickly before the first tooth sufficiently moved out of the path of the second tooth. Ex-1003, ¶149. A POSITA would have understood that various parameters may be modified to achieve acceptable treatment. *Id.*

A POSITA would have recognized that a subsequent (third) modification of the schedule of movement may include round-tripping differently from the first modification in any one of a variety of ways. In the context of Becker's disclosure, for example, the third modification may change (1) how far away the more lingual tooth moves to avoid the more buccal tooth, (2) the rate that the more lingual tooth moves out of the path of the more buccal tooth, (3) the treatment stage at which the more buccal tooth begins to move to ensure the more lingual tooth has had time to

move out of the way,[12] (4) the movement rate of the more buccal tooth to ensure that the more lingual tooth has had time to move out of the way, or (5) the movement direction for the more lingual tooth to ensure a collision is avoided. Ex-1003, ¶¶149-151. A POSITA also would have understood that modifying a schedule to include round-tripping is one of a finite number of identified, predictable solutions. *Id.*

G. Claim 7

1. [7(a)] The method of claim 1, further comprising: determining, by a computer processor, that the first modification does not avoid a collision between the first and second dental objects; and

Chishti-511 in view of Sachdeva discloses this feature for the same reasons discussed for limitation 5(a). *Supra* Section IX.E.1; Ex-1003, ¶152.

2. [7(b)] performing, by a computer processor after the determining, a second modification of the schedule of movement, the second modification comprising round-tripping the first dental object.

Chishti-511 in view of Sachdeva and Becker renders this limitation obvious for the same reasons discussed for limitations 1(e) and 6(b). *Supra* Sections IX.A.6 and IX.F.2; Ex-1003, ¶153. Although claim 6(b) recites performing round-tripping

[12] As discussed below for limitation 10(b) (*infra* Section IX.J.2), delaying initial movement of a tooth was well known and would have been obvious in this context. Ex-1003, ¶151 n.6.

as a third modification, as discussed, round-tripping would have been an obvious option for a first modification (claim 1(e)) or a second modification, as recited in claim 7(b). Ex-1003, ¶153.

H. Claim 8: The method of claim 1, further comprising producing a series of orthodontic appliances based at least on the modified schedule of movement, wherein each of the orthodontic appliances corresponds to a respective one of the treatment stages.

Chishti-511 discloses this feature. As Chishti-511 explains, its system uses a "series" of adjustments "using appliances," where "each appliance configuration represents a step along the treatment path." Ex-1004, 4:51-67, 1:33-58. Thus, Chishti-511 discloses a series of orthodontic appliances, each corresponding to a respective treatment stage. Ex-1003, ¶154.

Chishti-511 discloses that the appliances are manufactured (produced) after the schedule of movement is redefined and acceptable. Ex-1004, 4:51-6:6.

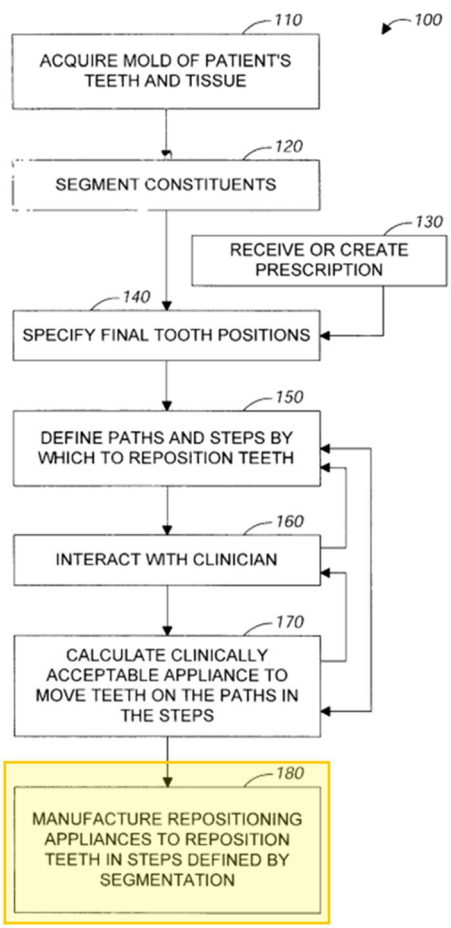


FIG. 1

Ex-1004, Fig. 1 (annotated). Thus, the series of orthodontic appliances is based at least on the modified schedule of movement. Ex-1003, ¶¶155-156.

I. Claim 9

1. [9(a)] The method of claim 8, wherein the producing comprises: fabricating a respective positive mold of the dental objects for at least two of the treatment stages; and

Chishti-511 discloses this feature, explaining that it generates "positive models to produce the repositioning appliance[s]," and that "adding a wax patch to the digital model will generate a positive mold that has the same added wax patch

geometry." Ex-1004, 9:43-56. Each appliance configuration represents one stage (of multiple) along the treatment path. Ex-1004, 4:51-67. A POSITA would have understood that because this manufacturing process produces aligners for each stage of the movement pattern, this fabrication would be required for at least two of the treatment stages, as claimed. Ex-1003, ¶¶157-158.

2. [9(b)] thermoforming a respective one of the orthodontic appliances over each of the respective positive molds.

Chishti-511 alone or in view of Chishti-876 renders this feature obvious. Chishti-511 discloses that its aligners are "manufactured by pressure fitting polymeric material over a positive physical model of the digital teeth." Ex-1004, 9:43-56. The claimed "thermoforming" is disclosed by Chishti-511's pressure-fitting manufacturing process. Ex-1003, ¶159. The '217 patent's only disclosure of a manufacturing technique relates to "pressure molding." *See* Ex-1001, 3:38-44 ("using a ***conventional pressure molding*** technique to form the appliance around the positive mold." (emphasis added)). A POSITA would have understood that thermoforming is a well-known manufacturing process whereby a plastic sheet is heated to a pliable temperature, shaped into a specific form using a mold, and then cooled to maintain its new shape. Pressure-fitting a polymeric material over a positive physical model of teeth—as disclosed in Chishti-511—would be understood by a POSITA to be a type of thermoforming, as pressure-fitting uses air

pressure in conjunction with the heated plastic sheet to help shape the appliance in the form of the mold. Indeed, the '217 patent admits that this process was known—the specification's only mention of a manufacturing technique describes "using a ***conventional pressure molding*** technique to form the appliance around the positive mold." Ex-1001, 3:38-44 (emphasis added). Thus, the '217 patent admits that the required fabrication process was merely "conventional," (*id.*), and a POSITA would have understood that the '217 patent's conventional manufacturing process, which is consistent with and matches Chishti-511's disclosure of pressure fitting, makes this limitation both disclosed and rendered obvious by Chishti-511. Ex-1003, ¶159.

If it is argued that Chishti-511 does not disclose this feature, this limitation is rendered obvious by Chishti-876, which discloses that dental appliances may be a "polymeric shell" manufactured "from a thin sheet of a suitable elastomeric polymer, such as Tru-Tain 0.03 in, ***thermal forming*** dental material." Ex-1005, 7:54-64 (emphasis added), 7:1-18; Ex-1003, ¶¶160-161. A POSITA would have understood that the disclosed thermal forming dental material would create Chishti-876's polymeric shells through the process of thermoforming the dental material over a respective positive mold (as described in Chishti-511). Ex-1003, ¶161.

Because Chishti-511 discloses manufacturing dental aligners, (Ex-1004, 9:43-56), a POSITA would have been motivated to look to ways to manufacture the

generated aligners, and Chishti-876 discloses known methods for manufacturing these dental appliances. Ex-1005, 7:54-64; Ex-1003, ¶162.

Using thermoforming for appliance manufacturing would have had a reasonable expectation of success, as thermoforming is just one of a finite number of identified, predictable solutions, and was a well-known and routine technique for aligner manufacturing at the relevant time. Ex-1003, ¶163. The '217 patent specification does not purport to have invented the technique. *See, e.g.*, Ex-1001, 3:38-44. The state of the art also confirms this technique was known. Ex-1016, 198 ("A thermoforming process is used for aligner fabrication."); Ex-1016, 18-23 (describing thermoforming to fabricate dental appliances in 1959). Accordingly, it would have been obvious to combine Chishti-876's disclosure of thermoforming with Chishti-511's disclosure of manufacturing dental aligners. Ex-1003, ¶163.

J. Claim 10

1. [10(a)] The method of claim 1, further comprising: performing, by a computer processor, a second modification of the schedule of movement in response to the identifying, the second modification comprising one or more of:

Chishti-511 discloses this feature and renders it obvious both alone and in view of Sachdeva.

If a collision is identified, Chishti-511 explains there is an unacceptable movement pattern and will require "changing the increments of tooth motion, i.e.,

changing the segmentation, on the treatment path, changing the path followed by one or more teeth in the treatment path, ***or both***." Ex-1004, 8:54-9:14 (emphasis added). A POSITA would have understood that more than one modification may be performed and may be necessary during the redefinition phase in response to the identification of an impending collision, and Chishti-511's process will perform a second modification or redefinition if necessary to avoid the collision. Ex-1003, ¶164. A POSITA would have understood that the movement of teeth in the crowded mouth of a patient with a malocclusion will often require multiple techniques involving coordinated teeth movements and may include the delaying, slowing, or stopping of teeth movement as teeth proceed to their final positions. *Id.*

For the same reasons as explained for limitations 1(c) and 1(d), to the extent it is argued that Chishti-511 does not disclose modifying the schedule of movement "in response to" identifying a collision, this feature is also disclosed by and obvious in view of Sachdeva. *Supra* Section IX.A.4-5; Ex-1003, ¶165.

2. [10(b)] delaying initial movement of the first dental object; and

Sachdeva discloses this feature. As explained for limitation 1(c), Sachdeva describes resolving conflicts among teeth. Ex-1007, 5:3-8; *supra* Section IX.A.4. Sachdeva discloses that in some circumstances, such as where "the lower tooth protrudes preventing the upper tooth from moving back, the lower tooth must be

moved before the upper tooth can be positioned" (delaying initial movement of the upper tooth). Ex-1007, 5:9-26. "Conversely, if the upper tooth is interfering with the lower tooth from being moved out, the upper tooth must first be moved" (delaying initial movement of the lower tooth). *Id.* A POSITA would have understood that, normally, teeth will move at the same time if possible. In the examples provided by Sachdeva, however, two teeth are prevented from initially moving together due to interfering with each other. A POSITA would have understood that Sachdeva discloses, in response to identifying a collision, delaying initial movement of a dental object to avoid a collision, as claimed. Ex-1003, ¶166.

Delaying may also be used as a second modification in combination with a first, round-tripping modification. As discussed for limitation 6(b), many parameters may be adjusted for the round-tripping technique to avoid collisions. *Supra* Section IX.F.2; Ex-1003, ¶167. In Becker's exemplary patient, the more lingual tooth is free to move in the mesio-distal plane unobstructed, yet a POSITA would recognize that for other patients, that tooth might not be able to move immediately. Ex-1003, ¶167. For example, movement of the more lingual tooth may be restricted by an incisor. *Id.* There, a POSITA would have recognized that the incisor may need to be moved first before the more lingual tooth may be moved out of the way of the more buccal tooth. *Id.* In such a situation, initial movement of

the more lingual tooth (the first dental object) would need to be delayed, as the incisor would take priority and need to be moved first, as disclosed in Sachdeva. *Id.*

Thus, this feature is rendered obvious by the combination of references. Ex-1003, ¶168.

3. [10(c)] slowing or stopping movement of the first dental object during one or more of the treatment stages following a previous one of the treatment stages during which the first dental object moved.

Chishti-511 in view of Chishti-876 and Sachdeva renders this limitation obvious. Limitations 10(b) and 10(c) recite that the second modification "compris[es] one or more of[] delaying … and slowing or stopping." When addressing the '444 patent, the PTAB interpreted the phrase "at least one of staggering and round-tripping" to require either staggering or round-tripping, not necessarily both steps. *See* Ex-1008, 8-9 (citation omitted). If a similar interpretation is applied here, no further disclosure is required because Sachdeva discloses the claimed delaying feature as discussed for limitation 10(b). Ex-1003, ¶169.

If it is argued that this limitation also requires "slowing or stopping movement," such movement would have been obvious for the same reasons as limitation 5(b). *Supra* Section IX.E.2; Ex-1003, ¶170. That section analyzes how and why slowing/stopping a dental object may be used as an option for a

modification of round-tripping. *Id.* A POSITA would have understood that the crowded geometry of a patient's teeth often requires multiple adjustments to a treatment plan to achieve an efficient and collision-free schedule of movement. Ex-1003, ¶170. Moreover, the analysis of limitations 10(b), 6(b), and 5(b) explain why the combination of delaying and slowing/stopping may be used (e.g., delaying the more lingual tooth if initial movement is obstructed and slowing/stopping the more lingual tooth as/before it moves to its previous and final positions, to ensure the more buccal tooth has time to pass by). Ex-1003, ¶170; *supra* Sections IX.E.2, IX.F.2, IX.J.2. Thus, claim 10 is obvious regardless of whether one or both of delaying and slowing/stopping are required. *Id.*

K. Independent Claim 11

Claim 11 recites features substantively identical to features in claim 1, except for differing language in the preamble and removal of "by a computer processor." *Compare* Ex-1001, 16:6-25, *with* Ex-1001, 17:17-37; *see also* Ex-1003, ¶171 (comparing claims).

Limitation 11(pre) recites "[a] non-transitory computer-readable medium comprising instructions that, when executed by one or more computer processors, cause at least one of the one or more computer processors to." Ex-1001, 17:17-20. If the preamble is limiting, Chishti-511 discloses it. Ex-1003, ¶172. As discussed

for limitation 1(b), Chishti-511 discloses that its system may be implemented in "computer programs" executed on "at least one programmable processor."[13] Ex-1004, 10:29-43; *supra* Section IX.A.3. Chishti-511 also discloses "[s]torage devices suitable for tangibly embodying computer program instructions" and "non-transitory computer-readable medium[s]." Ex-1004, 10:43-51; Ex-1003, ¶172.

Accordingly, claim limitations 11(pre)-11(e) are taught or suggested for the reasons discussed here and in Sections IX.A.1-.6, which discuss the corresponding portions of claim 1. Ex-1003, ¶173.

L. Claims 12-20

Claims 12 through 20 repeat or recite features that are substantively identical to features recited in claims 2-10, respectively. For example, claims 12, 19, and 20 recite additional features that are identical to features in claims 2, 9 and 10, respectively. Ex-1003, ¶174. See, for example, the similarities between claims 12 and 2:

[13] This applies equally to all remaining claim limitations, which recite "instructions [that], when executed by the one or more processors, further cause at least one of the one or more processors" to perform steps.

Claim 2	Claim 12
The method of claim 1, wherein the movement pattern is selected by a user.	The medium of claim 11, wherein the movement pattern is selected by a user.

Claims 13 and 14 are identical to claims 3 and 4, respectively, except for the removal of "by a computer processor" in claims 13 and 14. Ex-1003, ¶174. See, for example, the following minor differences between claims 13 and 3:

Claim 3	Claim 13
The method of claim 1, wherein the selecting comprises analyzing, by a computer processor, the dental objects in their respective initial and final positions.	The medium of claim 11, wherein the selecting comprises analyzing the dental objects in their respective initial and final positions.

Claims 15-18 have slightly more extensive changes to their wording relative to earlier claims, but they remain substantively identical to claims 5, 6, 7, and 8, respectively, and are met for the same reasons as discussed for the earlier claims. Ex-1003, ¶174. See, for example, the following minor differences between claims 5 and 15:

Claim 5	Claim 15
[5(a)] The method of claim 1, further comprising:	[15(a)] The medium of claim 11, wherein the instructions, when executed by the one or more processors, further cause at least one of the one or more processors to:

determining, by a computer processor, that the first modification does not avoid a collision between the first and second dental objects; and	determine that the first modification does not avoid a collision between the first and second dental objects; and
[5(b)] performing, by a computer processor after the determining, a second modification of the schedule of movement, the second modification comprising slowing or stopping movement of the first dental object during one or more of the treatment stages following a previous one of the treatment stages in which the first dental object moved.	[15(b)] perform, after the determining, a second modification of the schedule of movement, the second modification comprising slowing or stopping the movement of the first dental object during at least one of the treatment stages following a previous one of the treatment stages during which the first dental object moved.

Accordingly, claims 12-20 recite features that are substantively identical to features recited in claims 2-10, respectively. *Compare* Ex-1001, 16:26-17:16, *with* Ex-1001, 17:38-18:51; *see also* Ex-1003, ¶174 (comparing claims). They are therefore taught or suggested for the reasons discussed in Sections IX.B-J, which discuss the corresponding portions of claims 2-10. Ex-1003, ¶¶174-175.

X. THE BOARD SHOULD NOT EXERCISE DISCRETION TO DENY INSTITUTION

Petitioner stipulates that if institution is granted for the ’217 patent, it will not pursue in the parallel district court case for the ’217 patent any ground raised or that could have been reasonably raised in this Petition, and all defendants to the litigation have agreed to be bound by this stipulation. *See Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 19 (Dec. 1, 2020) (precedential as to §

II.A) ("Petitioner's stipulation here mitigates any concerns of duplicative efforts between the district court and the Board, as well as concerns of potentially conflicting decisions. . . . Thus, we find that this factor weighs strongly in favor of not exercising discretion to deny institution under 35 U.S.C. § 314(a).").

Petitioner reserves its right to oppose any argument Patent Owner may make regarding discretionary denial of this petition pursuant to the procedures set out in the Office's March 26, 2025 Memorandum ("Interim Processes for PTAB Workload Management").

XI. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Parties-in-Interest

The real parties-in-interest are ClearCorrect Operating LLC; ClearCorrect Holdings, Inc.; Straumann USA, LLC; and Institut Straumann AG.

B. Related Matters

To the best of Petitioner's knowledge, the '217 patent is involved in:

Align Technology, Inc. v. ClearCorrect Operating, LLC, et al., Case No. 6:24-cv-00187-ADA-DTG (W.D. Tex. Apr. 11, 2024).

C. Lead and Back-Up Counsel, and Service Information

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Petitioner consents to electronic service at the email addresses shown above and ClearCorrect-IPR-Attorneys@finnegan.com.

XII. GROUNDS FOR STANDING

The ’217 patent is available for *inter partes* review. Petitioner is not barred or estopped from requesting such review.

XIII. CONCLUSION

For the reasons above, Petitioner requests the Board institute *inter partes* review and find each challenged claim unpatentable.

Respectfully submitted,

Dated: April 12, 2025

By: /Luke McCammon/
Luke McCammon, Lead Counsel
Reg. No. 70,691

CERTIFICATION UNDER 37 C.F.R. § 42.24(D)

Pursuant to 37 C.F.R. § 42.24(d), the undersigned hereby certifies that the foregoing Petition contains 13,644 words, excluding those portions identified in 37 C.F.R. § 42.24(a), as measured by the word-processing system used to prepare this paper.

Respectfully submitted,

Dated: April 12, 2025

By: /Luke McCammon/
Luke McCammon, Lead Counsel
Reg. No. 70,691

CERTIFICATE OF SERVICE

The undersigned certifies that, in accordance with 37 C.F.R. §§ 42.6(e) and 42.105(a), the **Petition for *Inter Partes* Review of U.S. Patent No. 10,456,217, the associated Power of Attorney, and Exhibits 1001-1024, 1028-1030** were served via FedEx Priority Overnight delivery on April 12, 2025, on the correspondence address of record below indicated in the U.S. Patent Office's Patent Center for U.S. Patent No. 10,456,217:

Douglas J. Clark
Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

A courtesy copy has been concurrently served by the same means on Patent Owner's litigation counsel at:

Brian C. Nash
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Dated: April 12, 2025

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