Coll. Antropol. **24** (2000) 2: 479–484
UDC 572.544:611.92
Original scientific paper

Terminal Hinge Axis – Hobo Point – Frankfurt Horizontal Relations

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A B S T R A C T

Aim of this investigation was to determine the spatial relations of the terminal hinge axis of the temporomandibular joints toward Frankfurt horizontal. The sample consisted of 50 examinees. Terminal hinge axis was located, using Lauritzen's technique, on the left side of face for each examinee. Arbitrary point, as proposed by Sumiya Hobo, was measured and point Orbital was defined by palpation. On designated points steel pellets 0.25 mm in diameter were stocked. Lathero – latheral cephalogram was obtained for each examinee. Cephalograms were traced down on a transparent foil and points Orbital, THA – terminal hinge axis, Hobo and Porion – as the uppermost point of the metal ear rod of the cephalostat, were designated. Connecting points Orbital and Porion, Frankfurt horizontal was defined, and shortest distance toward points THA and Hobo, as well as between them were measured. Lines parallel and perpendicular to Frankfurt horizontal were drawn through point THA. In a co-ordinate system defined in such a way, upper left quadrant was first, upper right second, lower right third, and lower left was fourth. Observation was made in which quadrant Hobo point was located. Measured values were statistically evaluated. Results revealed that Hobo point is located in first quadrant in 5 cases, in second in 7, third quadrant in 18, and in fourth in 20 cases. That means that Hobo point is located lower to the THA point in majority of our population. Points THA and Hobo were not identical in any case. Mean values of variables showed that investigated points were inferior to the FH. Measures of variability revealed great variability of both points toward FH, as well as for their mutual distance. It could be pointed out that THA point should be defined kinematically during prosthodontic procedures, and that orientation in articulator's space should not be according to the FH.

Received for publication September 21, 2000.

Introduction

Importance of Terminal hinge axis (THA) for proper orientation of casts during prosthodontic treatment is well documented in literature[1–4]. Accurate reconstruction of occlusal surfaces, and through it, absence of interference during mandibular movements could be obtained only if casts are properly oriented in the articulator's space. That is possible if the mechanical axis of the articulator is identical to the Hinge axis of the temporomandibular joints[5–8]. Kinematic determination of the THA is time and skill consuming procedure. Because of that, arbitrary points proposed by many authors are often used[8–13]. There is no arbitrary point, which is identical to the THA in entire population. Discrepancies between mechanical axis of the articulator and kinematic THA lead to incorrect occlusal morphology during prosthodontic treatments and because of it, to interferences during movements of the mandible. Aim of this investigation was to determine the spatial relations of the Terminal hinge axis of the Temporomandibular joints toward arbitrary point proposed by Sumiya Hobo (H) and Frankfurt horizontal (FH).

Material and method

The sample consisted of 50 examinees with at least 28 teeth, with well-defined occlusal contacts, and no history of trauma or orthodontic treatment. Terminal hinge axis was located, using Lauritzen's technique, on the left side of face for each examinee[14,15]. Arbitrary point, as proposed by Sumiya Hobo, 12 mm anterior of the midpoint of the posterior rim of the tragus of the ear, and 5mm lower and perpendicular to the line Tragus – Canthus was determined. Point Orbital (O) was defined by palpation. On designated points steel pellets 0.25 mm in diameter were stocked. Because cephalometric method is often advocated in prosthodontic

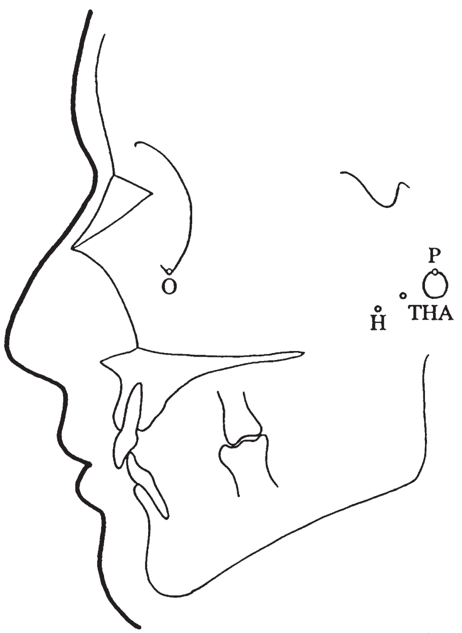

Fig. 1. Points used in the investigation O – orbitale, P – porion, THA – terminal hinge axis, H – Hobo point

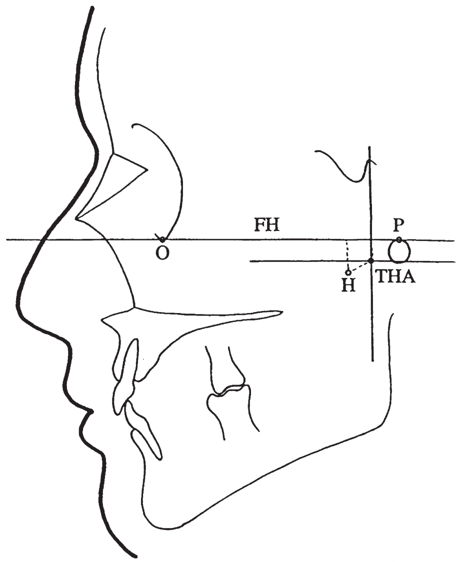

Fig. 2. Construction of the quadrants, and measured distances

treatment[16–21], lathero – latheral cephalogram was obtained for each examinee during orthodontic treatment. Cephalograms were traced down on a transparent foil and points Orbital, THA – terminal hinge axis, Hobo (H) and Porion (P) as the uppermost point of the metal ear rod of the cephalostat, were designated.

Connecting points O and P, Frankfurt horizontal was defined. Shortest distances from Frankfurt horizontal toward points THA and H, as well as between them were measured. Lines parallel and perpendicular to FH were drawn through point THA in order to obtain co-ordinate system. In a co-ordinate system defined in such a way, as clockwise, upper left quadrant was first, upper right second, lower right third, and lower left was fourth. Observation was made in which quadrant H point was located.

Results

TABLE 1
STATISTICAL EVALUATION

	THA	HOBO	THA–HOBO
M	4 mm	6.6 mm	4.3 mm
SD	3.0	2.7	2.3
CV	75.0	40.0	53.0

M = mean value; SD = standard deviation; CV = coefficient of variations

TABLE 2
LOCATION OF HOBO POINT IN QUADRANTS

	QU I	QU II	QU III	QU IV
HOBO	5	7	18	20
(%)	(10)	(14)	(36)	(40)

TABLE 3
DESCRIPTIVE STATISTICS FOR THE DISTANCE BETWEEN THA POINT AND FRANKFURT HORIZONTAL

Range	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0.00 < 1.00	4	8.00	4	8.00
1.00 < 2.00	9	18.00	13	26.00
2.00 < 3.00	6	12.00	19	38.00
3.00 < 4.00	12	24.00	31	62.00
4.00 < 5.00	5	10.00	36	72.00
5.00 < 6.00	4	8.00	40	80.00
6.00 < 7.00	1	2.00	41	82.00
7.00 < 8.00	2	4.00	43	86.00
8.00 < 9.00	1	2.00	44	88.00
9.00 < 10.00	2	4.00	46	92.00
10.00 < 11.00	2	4.00	48	96.00
11.00 < 12.00	0	0.00	48	96.00
12.00 < 13.00	2	4.00	50	100.00

TABLE 4
DESCRIPTIVE STATISTICS FOR THE DISTANCE BETWEEN HOBO POINT AND FRANKFURT HORIZONTAL

Range	Frequency	Percent	Cumulative Frequency	Cumulative Percent
2.00 < 3.00	3	6.00	3	6.00
3.00 < 4.00	5	10.00	8	16.00
4.00 < 5.00	7	14.00	15	30.00
5.00 < 6.00	6	12.00	21	42.00
6.00 < 7.00	10	20.00	31	62.00
7.00 < 8.00	4	8.00	35	70.00
8.00 < 9.00	7	14.00	42	84.00
9.00 < 10.00	2	4.00	44	88.00
10.00 < 11.00	2	4.00	46	92.00
11.00 < 12.00	1	2.00	47	94.00
12.00 < 13.00	3	6.00	50	100.00

TABLE 5
DESCRIPTIVE STATISTICS FOR THA – H DISTANCE

Range	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0.00 < 1.00	3	6.00	3	6.00
1.00 < 2.00	5	10.00	8	16.00
2.00 < 3.00	6	12.00	14	28.00
3.00 < 4.00	8	16.00	22	44.00
4.00 < 5.00	12	24.00	34	68.00
5.00 < 6.00	6	12.00	40	80.00
6.00 < 7.00	6	12.00	46	92.00
7.00 < 8.00	2	4.00	48	96.00
8.00 < 9.00	0	0.00	48	96.00
9.00 < 10.00	1	2.00	49	98.00
10.00 < 11.00	0	0.00	49	98.00
11.00 < 12.00	0	0.00	49	98.00
12.00 < 13.00	0	0.00	49	98.00
13.00 < 14.00	1	2.00	50	100.00

t-test (THA – H): $p < 0.001$

Discussion and conclusion

Mean value of distance between Terminal hinge axis point and Frankfurt horizontal was 4.0 mm in our investigation. Measured values have wide distribution (0.0mm to 12.9mm), with concentration under 6 mm (80% of measured values). So the small mean values seams expected. In similar investigation Vukovojac and Seifert have found 4.08 mm, Abdel-Razek 3–4 mm, and Gonzales and Kingery 7.1 mm[22–24]. They have stated that their result is in accordance with result of Bergstrom. Our result is in accordance with results of Vukovojac and Seifert, and Abdel – Razek. Discrepancies with the results of other authors may occur because they use different method of measurement. Measurements of variability reveal very significant morphological variations. Mean value of the distance between Hobo point and FH line was 6,6 mm in this investigation. Wide distribution (2.7 mm to 12.9 mm) with symmetric dispersion of the measured values, together with statistical measurements of variability reveals that Hobo point is not suitable for Face-Bow transfer. Our mean value is very close to the results of Gonzales and Kingery and Bergstrom for Terminal hinge axis. It is very interesting that measures of variability for the Hobo point are lower than for kinematically located Terminal hinge axis. Measured values for both points pointed out that only THA point is located on the Frankfurt horizontal in 3 cases (6%). Because of that, Frankfurt horizontal is not suitable for Face-Bow transfer, and orientation of casts in the articulator's space. Revealed mean value for the distance between investigated points is 4.3 mm, with standard deviation of 2.3 and coefficient of variability 53.0 in this investigation. Distribution of measured values for this variable is wide (0.8 mm to 1.35 mm), but concentration of values under 6 mm (80%), which is clinically tolerant, permit the use of the Hobo point in less demanding prosthodontic treatments[12,25]. Our result is almost identical to the result of Vukovojac and Seifert. It is also in accordance with results of Teteruck and Lundeen, Thorp et al., Lauritzen and Bodner, Schallhorn, Beck, and others[2,7,26–31]. Location of Hobo points in coordinate system is shown in Table II. Majority of Hobo points (76%) were under the kinematically determined Terminal hinge axis. Forty percent of the Hobo points were in fourth quadrant, what correspond with findings of Tamaki et al[32]. Our results are not in accordance with results of Abdal-Hadi. He had found that the majority of the arbitrary points, determined by his method would be in posterior superior quadrant (second quadrant. in our investigation). Following states of Mc Lean, Lucia, Bowley et al. and Fox it is obvious that its use will produce occlusal errors and incorrect cusp dimension during reconstruction of the masticatory apparatus[33–35]. Gordon et al. stated that errors in cusp height at the second molar ranged from 0.15 mm open space to 0.4 mm excess height. Mesiodistal errors ranged from 0.51 mm toward the distal to 0.52 mm toward the mesial[36].

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ODNOSI TERMINALNE ŠARNIRSKE OSI I HOBO TOČKE PREMA FRANKFURTSKOJ HORIZONTALI

S A Ž E T A K

Svrha istraživanja je utvrditi prostorni odnos terminalne šarnirske osi temporomandibularnih zglobova prema frankfurtskoj horizontali. U istraživanju je sudjelovalo 50 ispitanika. Svakom ispitaniku je na lijevoj strani lica lauritzenovom tehnikom određena terminalna šarnirska os, prosječna točka terminalne šarnirske osi prema Hobo-u određena je mjerenjem, a palpacijom definirana točka Orbitale. Sve točke su označene vodootpornom tintom. Na označene točke nalijepljene su metalne kuglice promjera 0,25 mm. Za svakog ispitanika napravljen je kefalogram u normi lateralis. Kefalogrami su precrtani na prozirnu foliju i na njoj su označene točke Orbitale, THA – terminalne šarnirske osi, Hobo točka i točka Porion – najviša točka olive kefalostata. Spajanjem točaka Porion i Orbitale definirana je Frankfurtska horizontala i izmjerene su najkraće udaljenosti do točaka THA i Hobo. Kroz točku THA povučena je linija paralelna s frankfurtskom horizontalom i linija okomita na nju. U tako definiranom koordinatnom sustavu gornji lijevi kvadrant označen je kao prvi, a ostali su označeni putem kazaljke sata. Udaljenost točaka Hobo i THA je izmjerena, uz oznaku u kojem kvadrantu se točka Hobo nalazi. Hobo točka se nalazila u prvom kvadrantu u 5 slučajeva, drugom u 7, trećem u 18 i četvrtom kvadrantu u 20 slučajeva. U većini naše populacije točka Hobo se nalazi ispod točke terminalne šarnirske osi. Točke nisu bile identične niti u jednom slučaju. Izmjerene vrijednosti udaljenosti točaka od Frankfurtske horizontale ukazuju na smještaj obiju točaka ispod te linije. Osnovni pokazatelji varijabilnosti otkrivaju veliku varijabilnost obje točke, kako međusobno tako i u odnosu na Frankfurtsku horizontalu. Može se zaključiti da se točka THA treba odrediti kinematski, a odljeve ne bi trebalo smještati u artikulatorski sustav pomoću Frankfurtske horizontale.