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A comparative radiographic evaluation of condylar position in wax check bite record; gothic arch tracing and post insertion of complete denture

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ABSTRACT

Aim

To determine the position of condyle radiographically in the wax check bite stage, the Gothic arch tracing and post insertion of denture to decide the clinically comfortable position of condyle at the dentulous and edentulous state can be determined by radiographic means.

Method

10 male patients from age group 45 to 65 years were selected. In order to standardize the intracranial radiograph of either side a modified radiographic head positioner was fabricated. For infracranial radiography, the patient was seated in the chair in the same position as that when the jaw relation was recorded. the relative position of condyle by radiographic means in different clinical stages i.e. in wax check bite record, Gothic arch tracing and post insertion of complete denture was recorded. Tracing of radiograph were obtained. And based on it study was concluded.

Result

It showed that the position of condyles is posterior most in gothic arch tracing, anterior most in the wax check bite record the position of condyle was anterior to gothic arch tracing and posterior to tentative jaw relation after denture insertion.

Conclusion

Findings showed that there existed unequal joint space between the head of condyle and the glenoid fossa at various stages of denture.

INTRODUCTION

Among the many concepts in denture construction which have been accepted by many professionals, the concept of the "Centric position" stands out as the vaguest and most ambiguous, Although certainly one of the most important. Recent research into Temporomandibular joint function suggest that a Re-evaluation of basic hypotheses indicated. Commonly accepted premises are taken and scientific facts because they are familiar and they produce empirically acceptable results. The position of the mandibular condyles in the glenoid fossae is an important factor for the success of prosthodontics treatment which may otherwise lead to temporomandibular joint disorders, myofascial pain dysfunction syndrome. while treating a complete edentulous patient we are supposed to establish the centric occlusion at the recorded centric relation. After recording the centric relation in wax check bite

record or in Gothic arch tracing method, Comparatively the position of the condyle should be same.

According to **kingery's** [28] controversy, it was thought that it is worthwhile to study if there is any change in the position of condyle at various clinical methods of recording jaw relation and post insertion of complete denture and during various steps in complete denture fabrication. The study was planned to determine the position of condyle radiographically in the wax check bite stage, the Gothic arch tracing and post insertion of denture to decide the clinically comfortable position of condyle at the dentulous and edentulous state can be determined by radiographic means.

AIMS AND OBJECTIVES

1. To find out the relative position of condyle by radiographic means in different clinical stages i.e. in wax check bite record, Gothic arch tracing and post insertion of complete denture.
2. Recording of clinical centric in wax check bite and its position of condyle.
3. Recording of clinical centric in Gothic arch tracing state and its position of condyle.
4. Recording of clinical centric after denture insertion and its position of condyle.
5. To check relative position of condyle at right and left side and its variation in wax check bite record, Gothic arch tracing and post denture insertion.
6. To standardize the accurate head position of patient and its relation to the X-ray machine by modified head positioner.
7. To evaluate the success rate at different Stages of denture preparation and after delivering the prosthesis after 7days of follow-up was determined.

MATERIALS AND METHODS

The following study was carried out in Government Dental College and Hospital, Nagpur, in the department of prosthetic dentistry. The study was undertaken to determine the position of condyle at various methods of recording centric relation in wax check bite record and the Gothic arch tracing and its effects in complete denture fabrication by radiographic examination.

Criteria for selection of patients

10 male patients from age group 45 to 65 years were selected amongst those visiting the department of prosthetic dentistry. Such completely edentulous patients were examined thoroughly. Priority to the healthy oral conditions were given. Conditions such as healthy alveolar ridges, non-flabby tissues, normal TMJ movements, normal ridge relationship, patient's economic status, General Health were taken into consideration.

Clinical examination and consent

A thorough clinical examination of the oral cavity and extra oral structures was carried out. A detailed history was obtained by direct questioning and patients consent was taken.

Radiographic head positioner

In order to standardize the infracranial radiograph of either side a modified radiographic head positioner was fabricated. It was similar to that of **Arthur H. Wuhermann's** [1] metallic collimator holding device. The localizer collimator is not available, commercially but it can be custom made. The localizer so constructed that the space between the collimator and localizing nuts can be changed. The relationship between the parts remain constant except for the change in distance; opening or closing of appliance must not change the level of the nut in their relationship to the central Ray. Prior to initial use of the localizer, the nuts must be adjusted and locked, so that they are in exact centre of the radiation. The present modified head positioner can be divided into three parts:-

1. The horizontal bar to adjust the distance of cone and film.
2. The vertical arm for holding the X-ray cone.
3. The vertical arm for holding the cassette of radiographic film.

The horizontal bar

It consists of two rods; one embedded into another which has a sliding mechanism. Also it consists of a measuring scale and a thumb screw to tighten the sliding rod. Measuring scale is so fixed that the zero coincides with one end of the sliding bar.

Vertical arm for holding the X-ray cone

The cone is fabricated in clear methyl methacrylate resin in which the X-ray cone fits. It is mounted on an acrylic ring that has a taper and rotates around an axis to adjust the horizontal angulation with the help of screw.

The whole assembly can slide vertically downwards and upwards with the help of the thumb screw to which again a pointer is attached for recording the readings. To measure the horizontal angulation a protractor is fixed with a pointer attached to the ring.

The vertical arm for holding the Cassette of radiographic film

It consists of a "U" shaped cassette holding device made up of clear acrylic resin at the lower end. The whole cassette holding device can slide with the help of thumb screw to which again a pointer is attached to mark the readings.

Technique of infracranial radiograph

For the Infracranial projection, an X-ray film cassette is positioned against the side of the patients Head, parallel to the sagittal plane, next to the TMJ of interest. The X-ray tube head is placed on the side of the skull opposite the TMJ to be imaged. It is angulated so that the control beam is directed cranially 5 to 10 degrees and approximately 10 degrees posteriorly. This position ideally directs the central x-ray beam through the tube side mandibular sigmoid notch, below the base of the skull, through the oropharynx and finally through the film.

Position of the patient and radiographic headpositioner

For infracranial radiography, the patient was seated in the chair in the same position as that when the jaw relation was recorded. The radiographic head positioner was positioned in such way that the horizontal bar was touching the patient's head. The cassette for radiographic size of 6"× 8" was placed in the "U" shape cassette holding device and x-ray cone was placed in such a way that it fixed snugly in the cone of same size and shape of the radiographic head positioner.

Fabrication of complete dentures in balanced occlusion

After thorough clinical evaluation and detailed case history, complete denture for each patient was fabricated in balanced occlusion following each step meticulously. Initially the primary impression in compound (Y-dents) was made. Primary Casts were obtained in plaster of Paris and special trays in tray material were made. Final impression was recorded by establishing the peripheral seal in low fusing compound (Aslate) and wash impression in zinc oxide eugenol paste for (polynol). After preparation of the final cast, permanent record bases of heat curing polymethylmethacrylate resin (stellon) were made by slow curing cycle. Jaw relation was recorded by the wax check bite record. After this the infracranial radiograph of either side of TMJ as described in the technique was taken in the department of oral diagnosis, medicine and radiology of government Dental College and Hospital, Nagpur. After the radiograph, face bow record and transfer was done and extraoral Gothic arch tracing were made. Intraoral plaster records were made in centric relation and protrusive position after which again radiographs of either side were taken. Patients dentures were selected and arranged in balanced occlusion after try-in, the dentures were fabricated and delivered. patients were asked to take care regarding the oral hygiene and cleanliness of dentures. After 7 days when patient was adapted to dentures, again radiographs of either side were Taken with the same readings on scale with dentures in centric occlusion in patient's oral cavity.

Tracing of radiographs

The radiograph was checked for the quality and clearance. The external auditory meatus, the glenoid fossa and the head of the condyle was traced with a microtip pen of black colour directly on the X-ray by keeping it on the X-ray viewer. All the tracings were then transferred on the graph papers with the help of carbon paper.

Method of measurement

As described by **Ismail and rokani in 1980**[22] the method consists of considering the point M- the center of external auditory meatus. From point M, 13 mm to the glenoid fossa, a point S its fixed, which was taken to be the superior point of

glenoidfossa and as another reference point. From point S, 1cm posteriorly on the glenoidfossa, a point P was fixed and was considered as the posterior reference point. From point S anteriorly again 1cm point A was fixed and was considered as the anterior reference point. After fixing up the points, the perpendicular lines from point S, P and A were drawn on the head of condyle. The point thus obtained were a S1, P1 and A 1 respectively. The tangents to condylar surface through S1, P1 and A1 and parallel lines passing through S, P and A, were drawn.The distance between S and S1 was taken the superior space between the Condyle and glenoid fossa; from P to P1 the posterior space and A to A1 the anterior space between condyle and glenoid fossa. The readings were measured on the graph paper. The reading were Taken of 6 radiographs of each patients; two each shooted after wax check bite records, Gothic arch tracing and 7 days of recall of the denture insertion stage and thus the relative position of condyle was observed.

DISCUSSION

Centric relation is a classical reference and treatment position in complete denture Prosthesis. It has been defined in so many different ways that its creditability for the clinician is questionable. According to glossary of prosthodontics term, "centric relation is defined as the maxillomandibular relationship in which the condyles articulate with the thinnest avascular portion of their respective disks with the complex in the anterosuperior position against the slopes of the articular eminences. This position is independent of tooth contact. This position is clinically discernible when the mandible is added directed superiorly and anteriorly. It is restricted to a purely rotary movement about the transverse horizontal axis". The present study had tried to find out the amount of displacement in condylar position in relation to various methods of Jaw relation record by TMJ radiographs. Radiographs of either side of TMJ were made to check for the position of condyle at three different stages.

1. Wax check bite record.
2. Gothic arch tracing and
3. Post denture insertion

The relative position of condyle was assessed by measuring the spatial difference between the glenoid fossa and the head of the condyle. The present study has shown no significant difference in the supero inferior position of condyle. The second point is that the circumcondylar joint spaces do not appear to have been of equal in size radiographically. This finding was in agreement with the finding of **Lawrence A Weinberg**[35]**.**The study also reveals that there is a significant change in position of condyle in various methods of recording centric relation.

In the present study, a significant change in the position of condyle was found in different methods of recording centric relation. The position of condyle in wax check bite record was found to be anterior than the position of condyle in Gothic arch tracing method, also there was a significant change in the position of condyle after the denture insertion. The position of condyle after 7 days of recall after denture delivery was found to be anterior to the position of condyle in Gothic arch tracing but the position was not as anterior as the position in the wax check bite record.

Although the literature Bounds with many studies done on the temporomandibular joint and related structures, no attempts have been made to study the position of condyle at various stages of denture fabrication and to find the change in relative position of condyles radiographically. From the present study, we can state that the Gothic arch tracing method is superior over the wax check bite record method as the position of condyle lies nearer to the Gothic arch tracing method after denture insertion.

Since the TMJ radiographs serve as an important aid in diagnosis and treatment planning, in prosthodontics, in the planning of complete denture treatment, it is essential to determine the position of condyle after recording the centric relation. This can be considered for the future reference while treating the patient by new centric relation. Hence the TMJ radiographs aid us to determine the position of condyle in the centre relation. It is to be noted that there were few limitations in the study. Since the position of condyle is an area, a three dimensional view is a necessary to assess its position.

RESULT

Table No 1. Showing values of measurement of distance Between S-S1, P-P1, A-A1 of right and left sides (in mm)

S.NO.	POINT	TJR		GAT		DO	
		RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
1.	S-S1	2	1.5	1.5	1	3	2
	P-P1	1	1	0.5	1.5	2	2.5
	A-A1	2.5	1.5	2	2	1	0.5
2.	S-S1	3	4	2.5	3	3	3
	P-P1	2.5	2	2	1.5	2	3
	A-A1	1.5	1	2.5	2	2.5	0.5
3.	S-S1	2	1.5	1	2	2	1.5
	P-P1	1.5	1	1	1	1.5	1
	A-A1	0.5	0.5	2	2	1	2
4.	S-S1	1.5	3	1	3	3	3
	P-P1	2	1.5	1	1	1	1
	A-A1	4	4	3	3	3	4
5.	S-S1	4	4	2	3	3	3
	P-P1	5	3	1	1.5	3	1.5
	A-A1	2	1.5	0.5	2	1	1
6.	S-S1	1.5	4	3	2	3	2
	P-P1	1	2	1	1.5	1	2
	A-A1	1	0.5	1	1.5	2	2
7.	S-S1	4	2	2	3	3	3
	P-P1	4	2	1	2	2	2
	A-A1	2	2	3	1	1	1
8.	S-S1	4	2	2	2	1	2
	P-P1	6	1	1	1	1	1
	A-A1	1	2	2	2	1	1
9.	S-S1	4	5	2	4	1	5
	P-P1	3	2	2	1.5	1	1
	A-A1	2	1	1	1	1	1
10.	S-S1	1	1.5	2	1	1	1
	P-P1	2	1.5	1.5	1	2	1.5
	A-A1	4	5	2	4	4	2.5

Table no. 2 Showing the difference between TJR, GAT and DD of the right and left side In mm

Pts No.	POINTS	From TJR to GAT		From GAT to DD		From TJR to DD	
		RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
1	S-S1	0.5	0.5	1.5	1	1	0.5
	P-P1	0.5	0.5	0.5	1	1	1.5
	A-A1	0.5	0.5	1	1.5	1.5	1
2	S-S1	0.5	1	0.5	0	0	1
	P-P1	0.5	0.5	0	1.5	0.5	1
	A-A1	1	1	0	1.5	1	0.5
3	S-S1	1	0.5	1	0.5	0	0
	P-P1	0.5	0	0.5	0	0	0
	A-A1	1.5	1.5	1	0	0.5	1.5
4	S-S1	0.5	0	2	0	1.5	0

	P-P1	1	0.5	0	0	1	0.5
	A-A1	1	1	0	1	1	0
5	S-S1	2	1	1	0	1	1
	P-P1	4	1.5	2	0	2	1.5
	A-A1	1.5	0.5	0.5	1	1	0.5
6	S-S1	1.5	2	0	0	1.5	2
	P-P1	0	0.5	0	0.5	0	0
	A-A1	0	1	1	0.5	1	1.5
7	S-S1	2	1	1	0	1	1
	P-P1	3	0	1	0	2	0
	A-A1	1	1	1	2	1	1
8	S-S1	2	0	1	0	3	0
	P-P1	5	0	0	0	5	0
	A-A1	1	0	1	1	0	1
9	S-S1	2	1	1	1	3	0
	P-P1	1	0.5	1	0.5	2	1
	A-A1	1	0	1	0	1	0
10	S-S1	1	0.5	1	0	0	0.5
	P-P1	0.5	0.5	0.5	0.5	0	0
	A-A1	2	1	2	1.5	0	2.5

Table No.3 Showing the values of difference between right and left side in TJR, GAT and DD (in mm).

PTS NO.	POINTS	DIFFERENCE FROM RIGHT TO LEFT SIDE		
		TJR	GAT	DD
1	S-S1	0.5	0.5	1
	P-P1	0	0	0.5
	A-A1	1	0	0.5
2	S-S1	1	0.5	0
	P-P1	0.5	0.5	1
	A-A1	0.5	0.5	1
3	S-S1	0.5	0	0.5
	P-P1	0.5	0.5	0.5
	A-A1	0	1	1
4	S-S1	1.5	0	0
	P-P1	0.5	0	1
	A-A1	0	1	1
5	S-S1	0	1	0
	P-P1	2	0.5	1.5
	A-A1	0.5	1.5	0
6	S-S1	2.5	1	1
	P-P1	1	0.5	1
	A-A1	0.5	0.5	0
7	S-S1	2	2	0
	P-P1	2	2.5	0
	A-A1	0	0.5	0
8	S-S1	2	0	1
	P-P1	5	0	0
	A-A1	1	0	0

9	S-S1	1	2	4
	P-P1	1	0.5	0
	A-A1	1	0	0
10	S-S1	0.5	1	0
	P-P1	0.5	0.5	0.5
	A-A1	1	2	1.5

Table no. 4. Showing the mean value of the right and left sides

POINT	TJR		GAT		DD	
	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
S-S1	2.70	2.85	1.90	2.40	2.30	2.55
P-P1	2.80	1.70	1.20	1.35	1.65	1.65
A-A1	2.05	1.90	1.90	2.05	1.70	1.55

Table no. 5 showing the standard deviation value of the right and left sides

POINT	TJR		GAT		DD	
	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
S-S1	1.22	1.31	0.61	0.96	0.94	1.11
P-P1	1.70	0.63	0.48	0.33	0.66	0.70
A-A1	1.18	1.48	0.84	0.89	1.07	1.09

Table no. 6 showing the difference between the mean value of TJR, gat and DD of the right and left side (in mm)

POINTS	FROM TJR TO GAT		FROM GAT TO DD		FROM TJR TO DD	
	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
S-S1	0.80	0.45	0.40	0.15	0.40	0.30
P-P1	1.60	0.35	0.45	0.30	1.15	0.05
A-A1	0.15	0.20	1.20	0.50	0.35	0.35

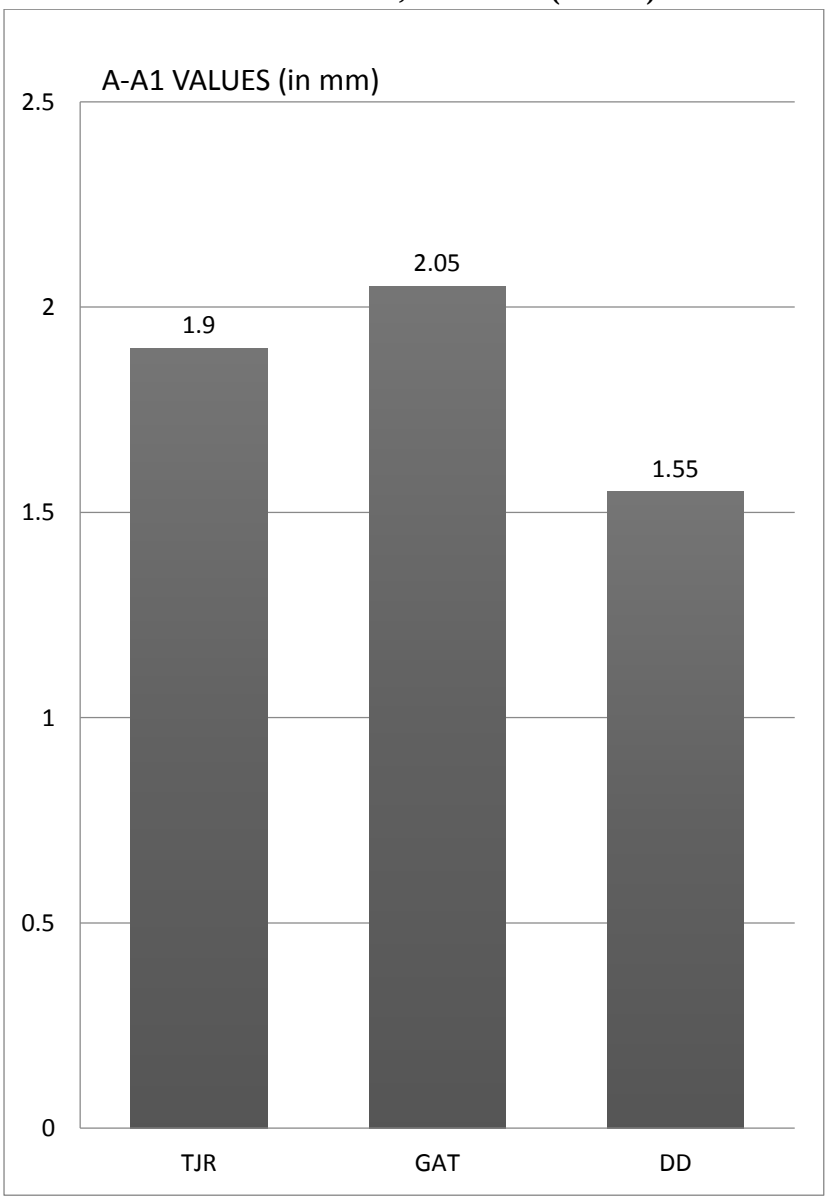
Table No. 7.Showing the‘t’ value of TJR,GATand DD of the right and let side

POINTS	FROM TJR TO GAT		FROM GAT TO DD		FROM TJR TO DD	
	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
S-S1	0.90	0.90	1.20	0.33	0.85	0.56
P-P1	2.11	2.40	2.30	2.74	1.90	2.42
A-A1	2.42	2.68	2.32	2.80	2.10	2.32

Table No.8.Showing the significance in percentage values of the TJR,GAT and DD of right and left side.

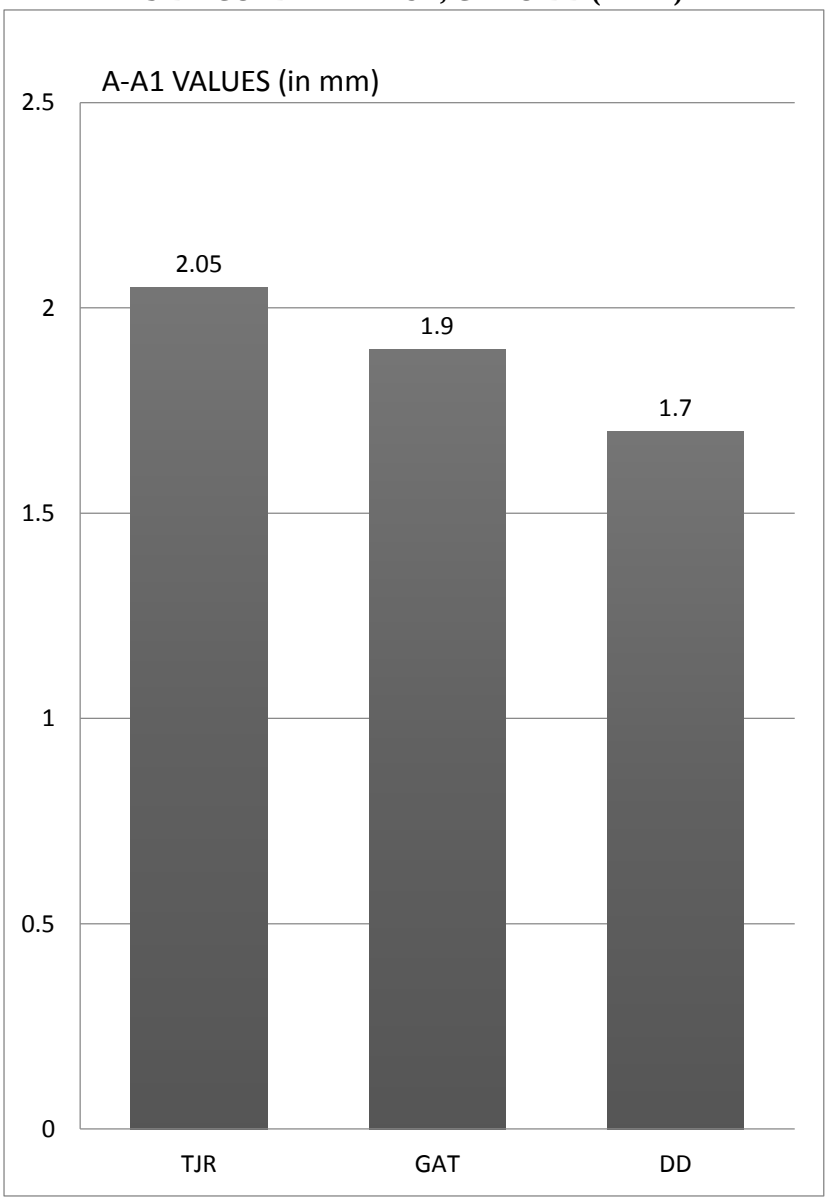
POINTS	FROM TJR TO GAT		FROM GAT TO DD		FROM TJR TO DD	
	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
S-S1	NS	NS	NS	NS	NS	NS
P-P1	0.05%	0.03%	0.02%	0.01%	0.07%	0.05%
A-A1	0.03%	0.02%	0.02%	0.02%	0.05%	0.05%

DIAGRAM SHOWING COMPARATIVE MEAN VALUE OF THE ANTERIOR POSITION OF LEFT SIDE CONDYLE IN TJR, GAT & DD (IN MM)



STAGES

DIAGRAM SHOWING COMPARATIVE MEAN VALUE OF THE ANTERIOR POSITION OF RIGHT SIDE CONDYLE IN TJR, GAT & DD (in mm)



STAGES

DIAGRAM SHOWING COMPARATIVE MEAN VALUE OF THE POSTERIOR POSITION OF LEFT SIDE CONDYLE IN TJR, GAT & DD (in mm)

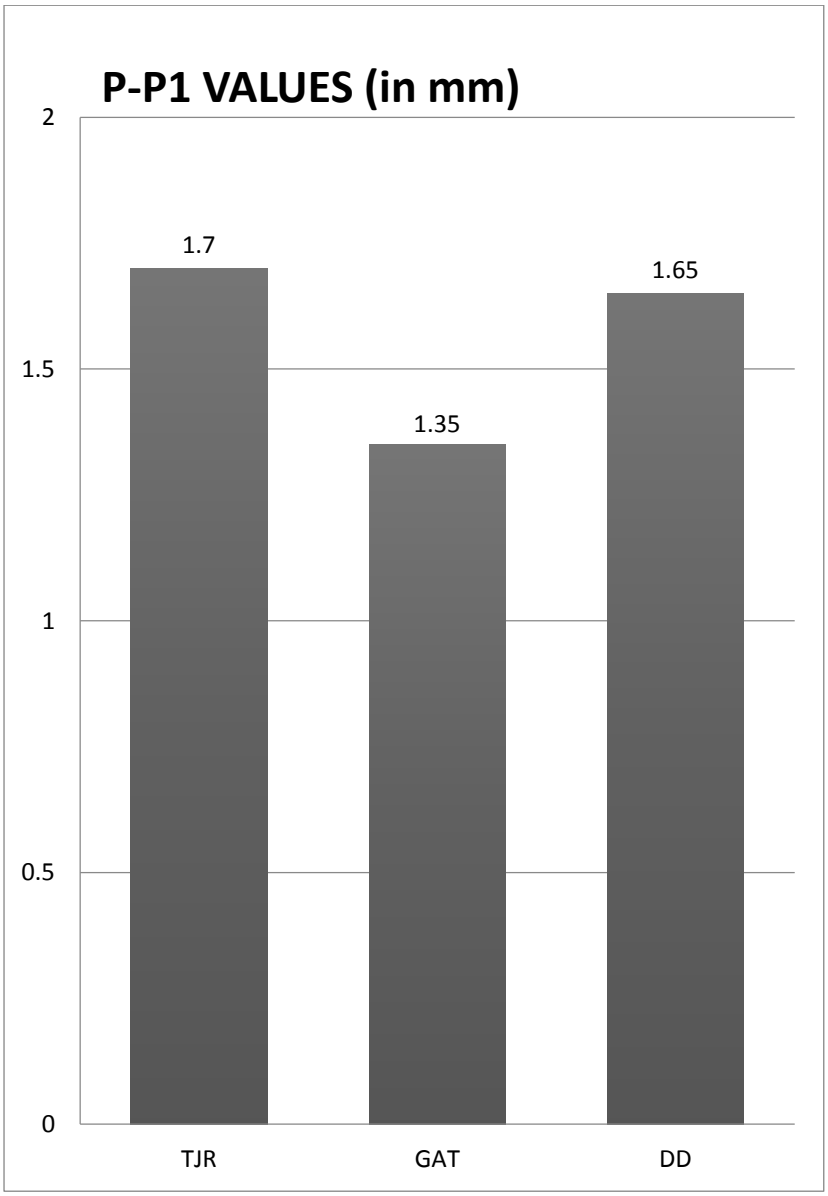
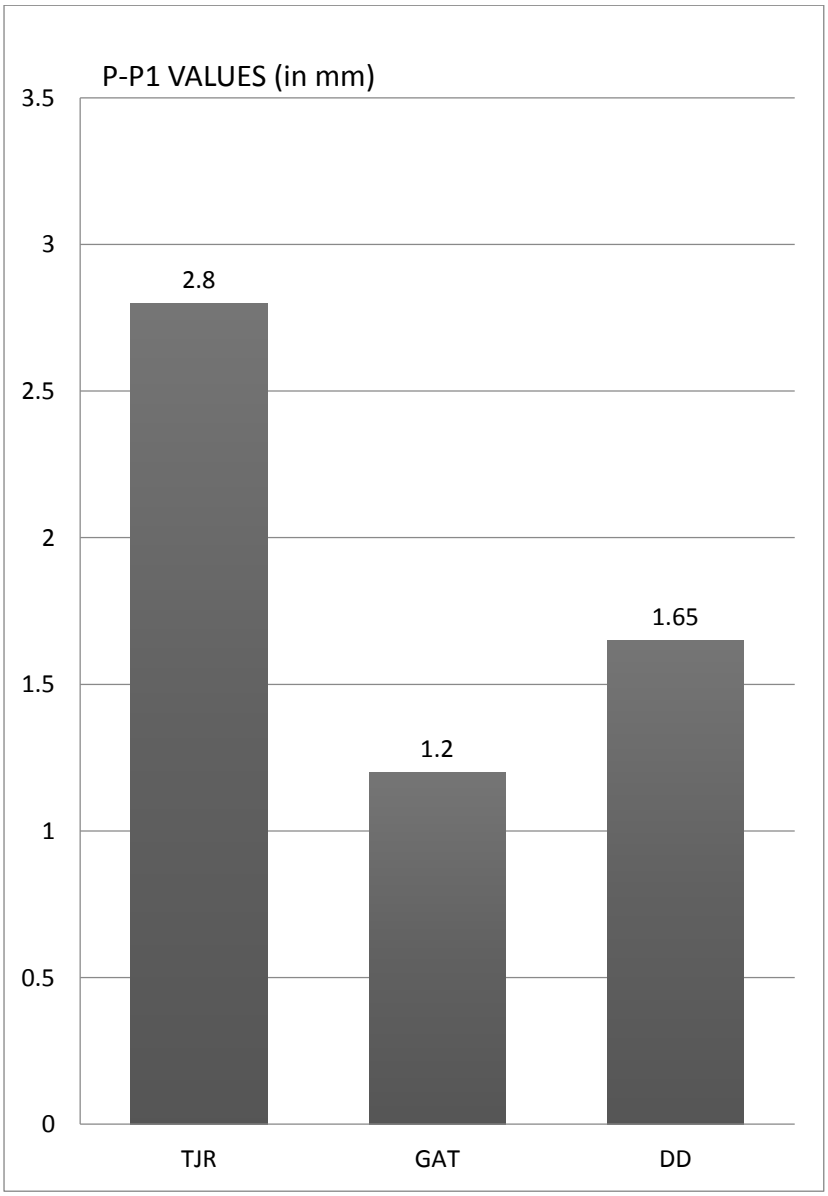


DIAGRAM SHOWING COMPARATIVE MEAN VALUE OF THE POSTERIOR POSITION OF RIGHT SIDE CONDYLE IN TJR, GAT & DD (in mm)



STAGES

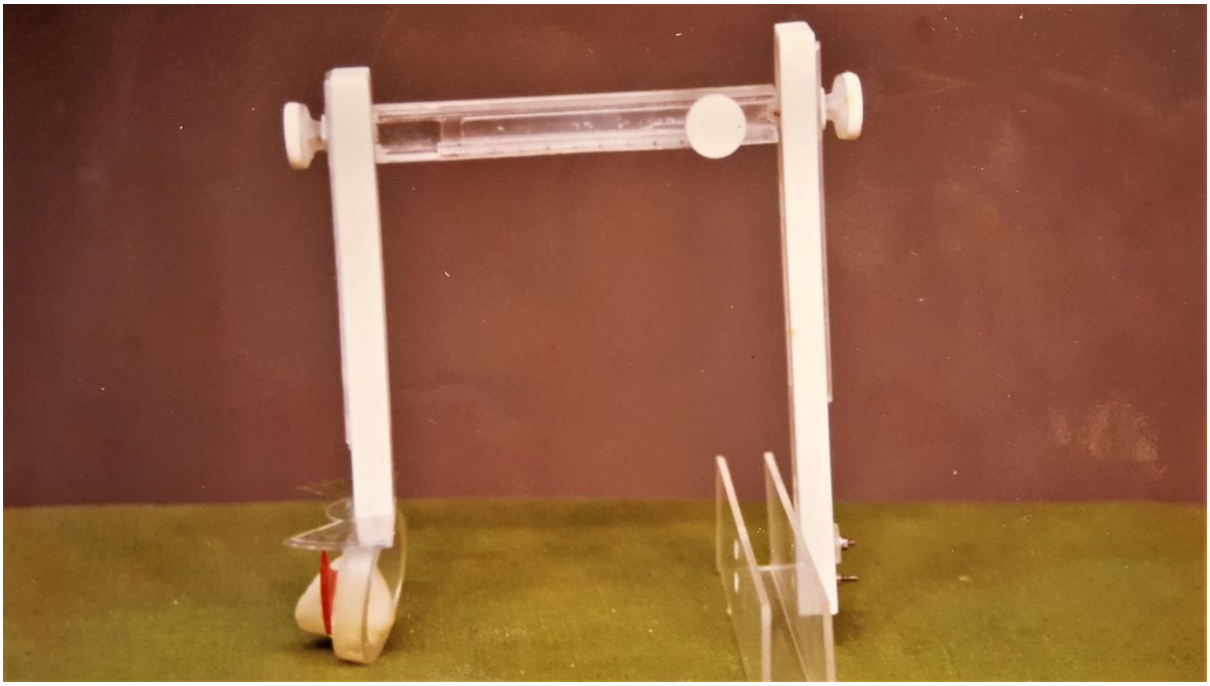


Fig.1. Modified radiographic head positioned
(Front view)

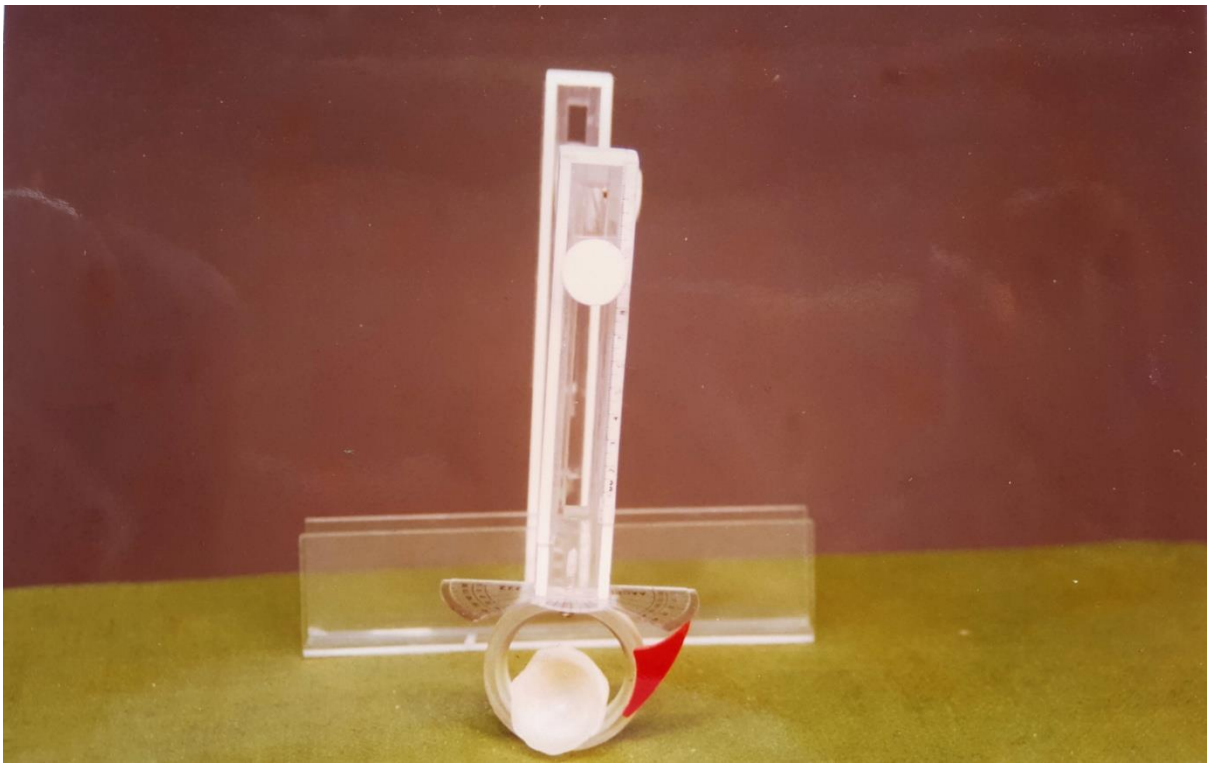


Fig. 2. Modified radiographic head positioned
(Side view)

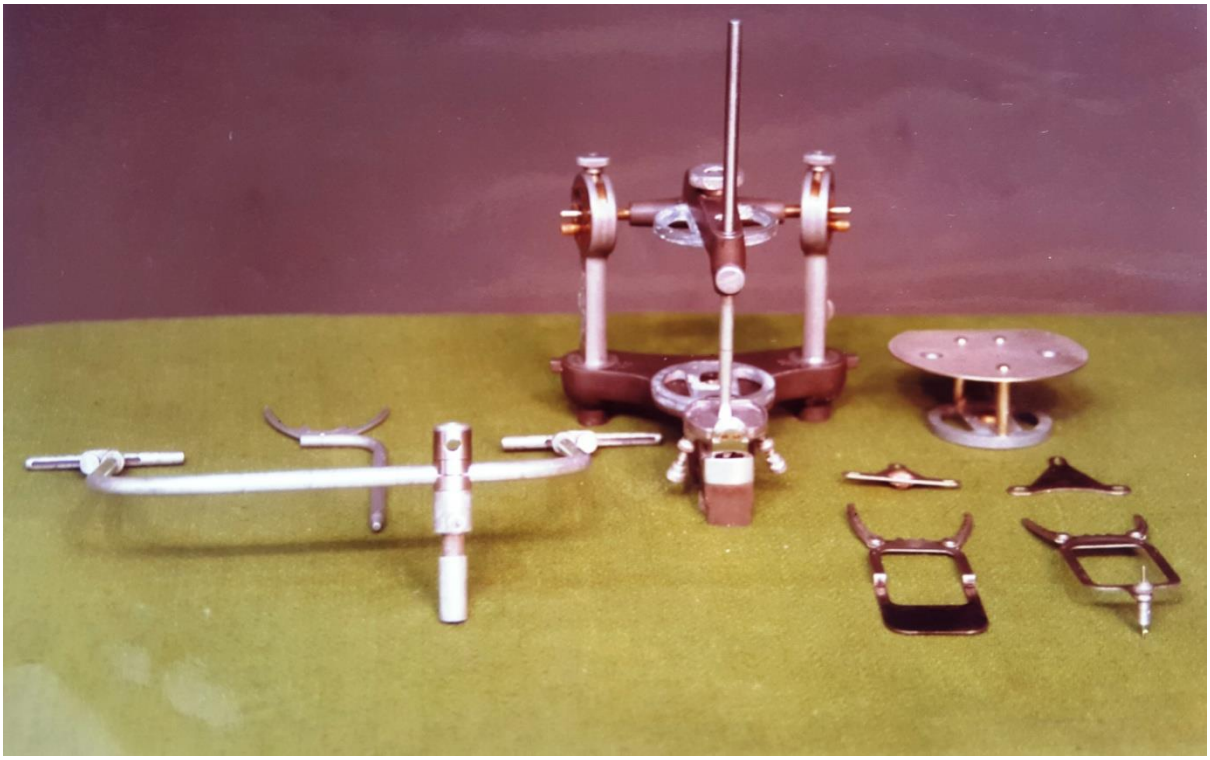


Fig. 3. Armamentarium

Fig. 4. Patient Selection

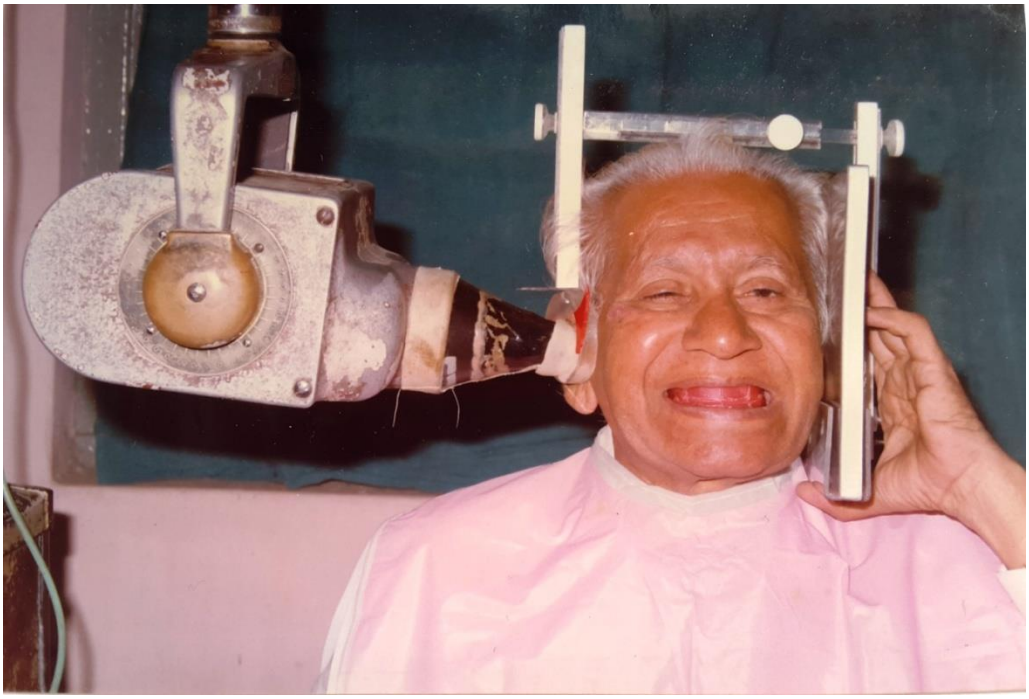


Fig. 5.Infracranial radiographic technique after Wax check bite record (Front view)

Fig. 6.Infracranial radiographic technique after Wax check bite record (side view)

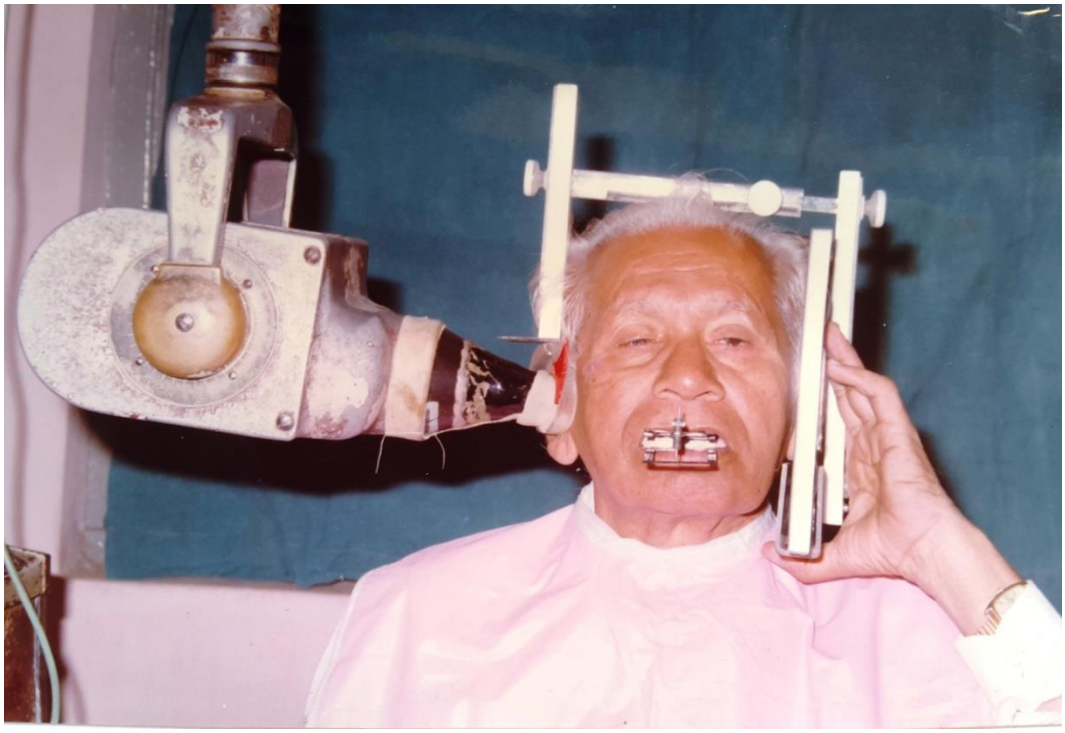


Fig .7.infracranial radiographic technique after gothic arch tracing (Front view)

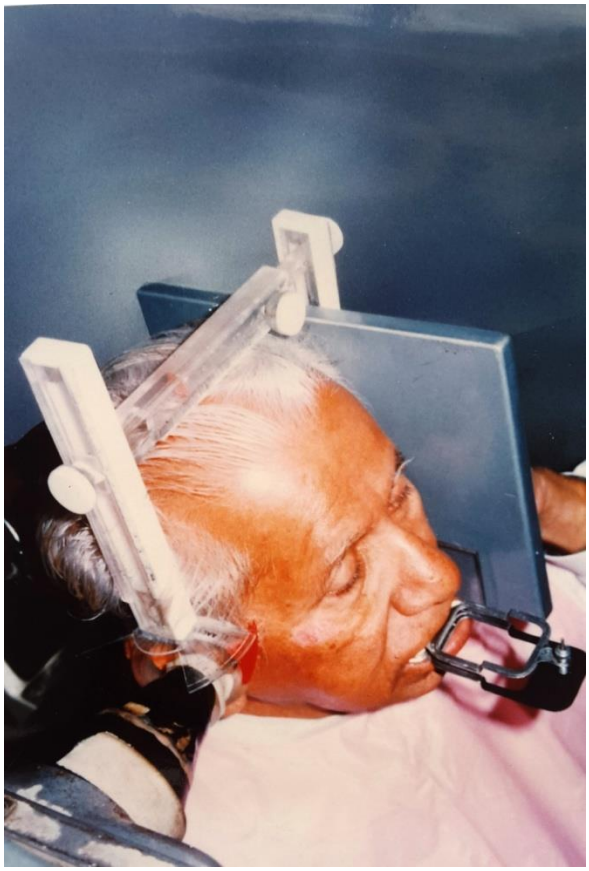


Fig.8.Infracranial radiographic technique aftergothic arch tracing (side view)

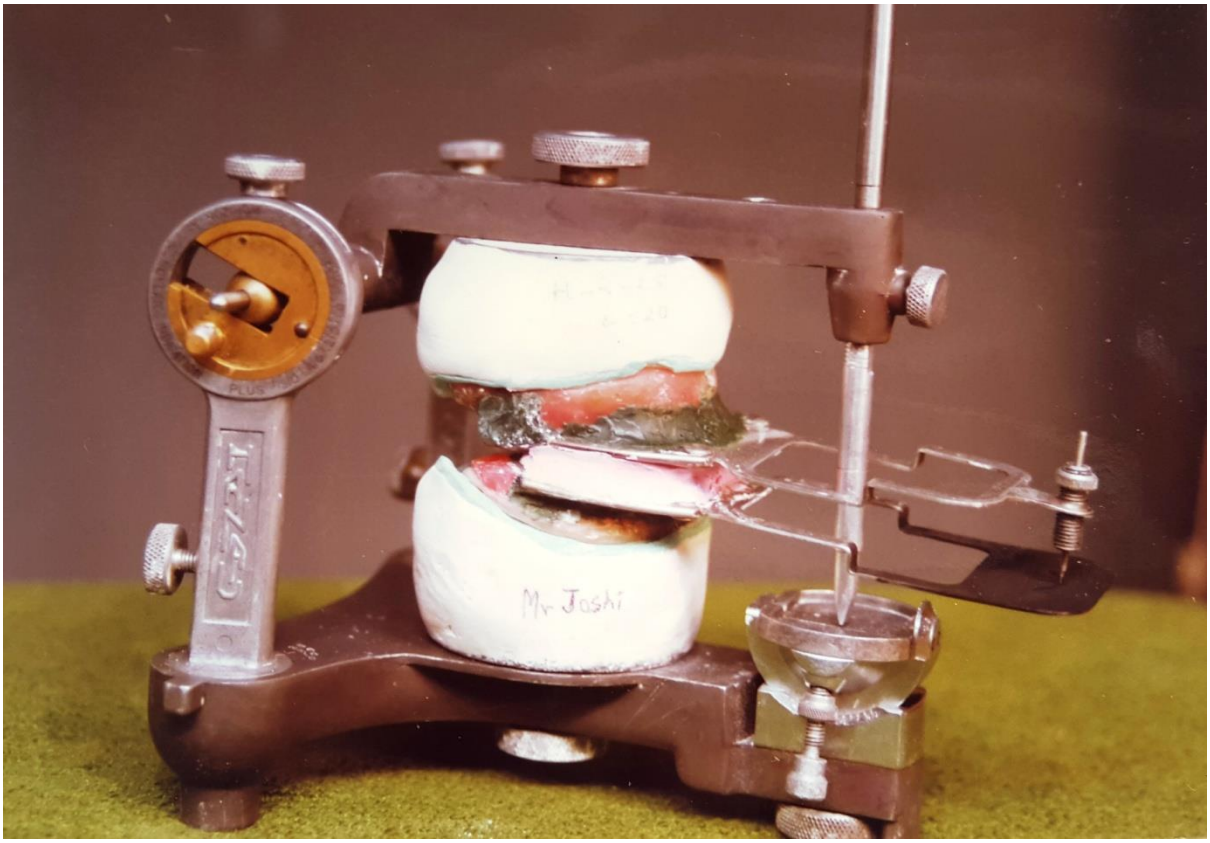


Fig .9. Transfer of jaw relation on the Hanau (H_2 series non arcon) articulator

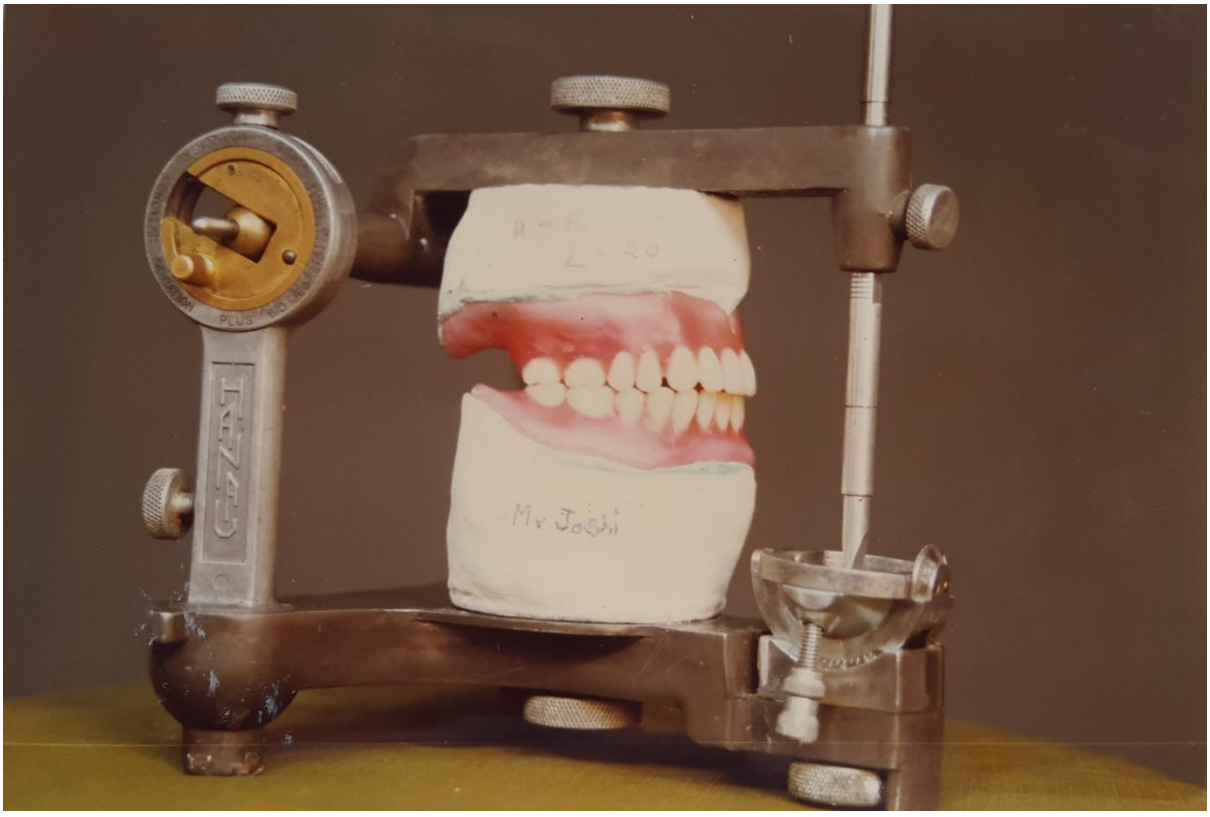


Fig .10.Trial denture on the articulator

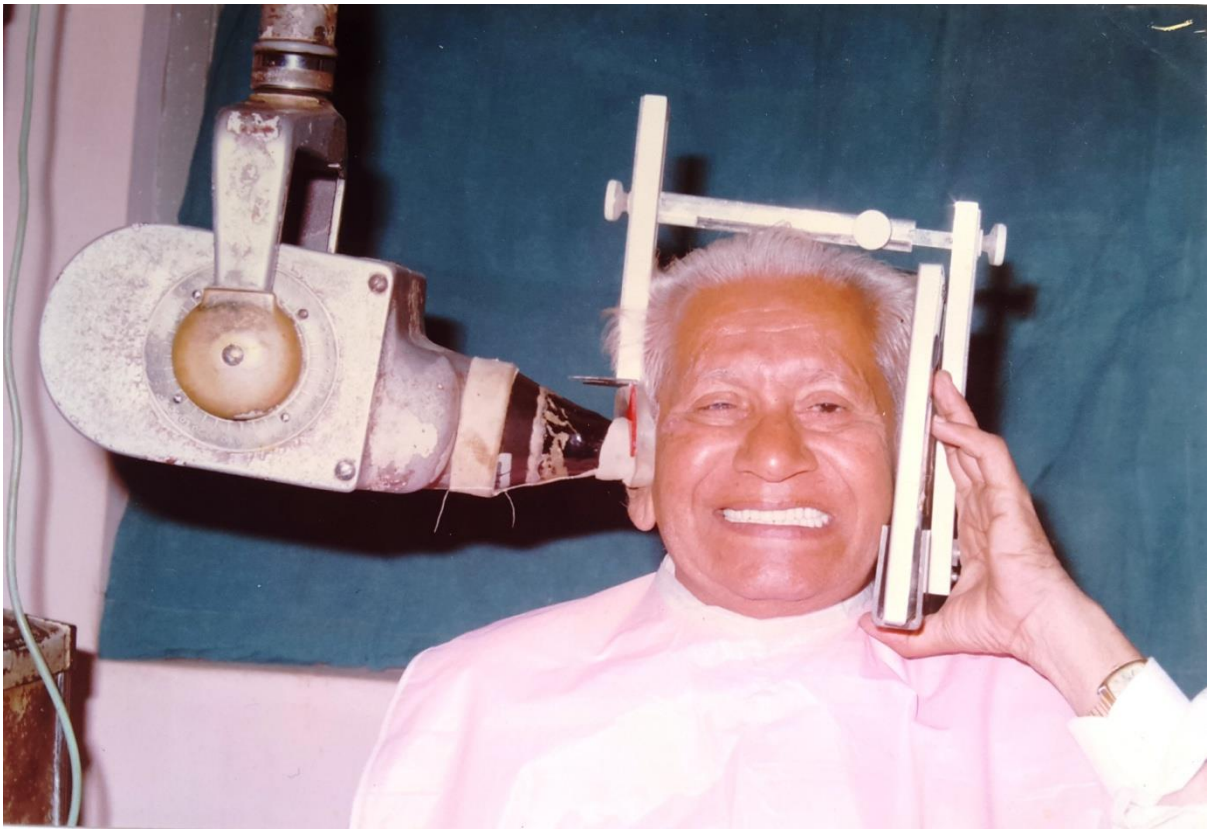


Fig .11.Infracranial radiographic technique after denture insertion (front view)

Fig .12.infracranial radiographic technique after denture insertion (Side view)

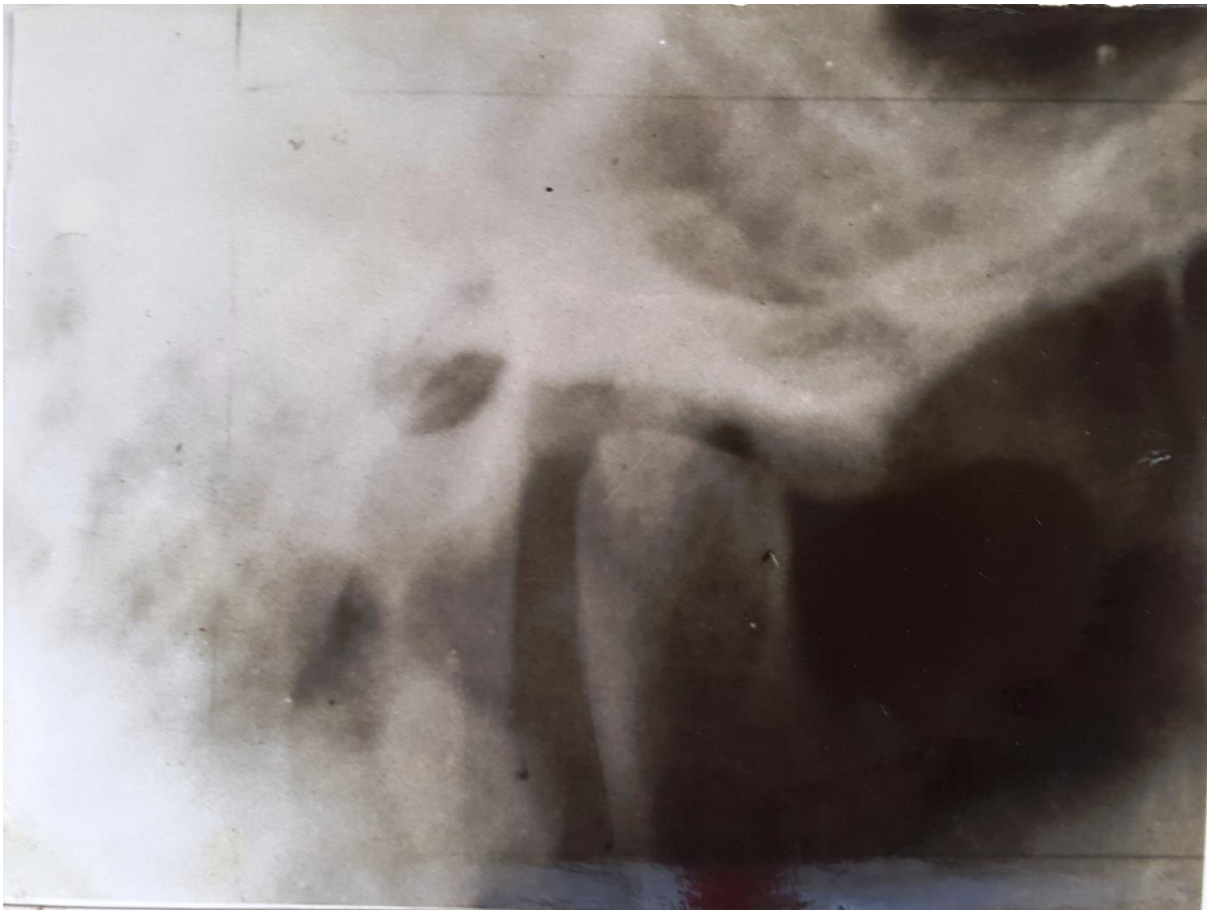


Fig .13.Radiograph of right side condyle after wax check bite record.

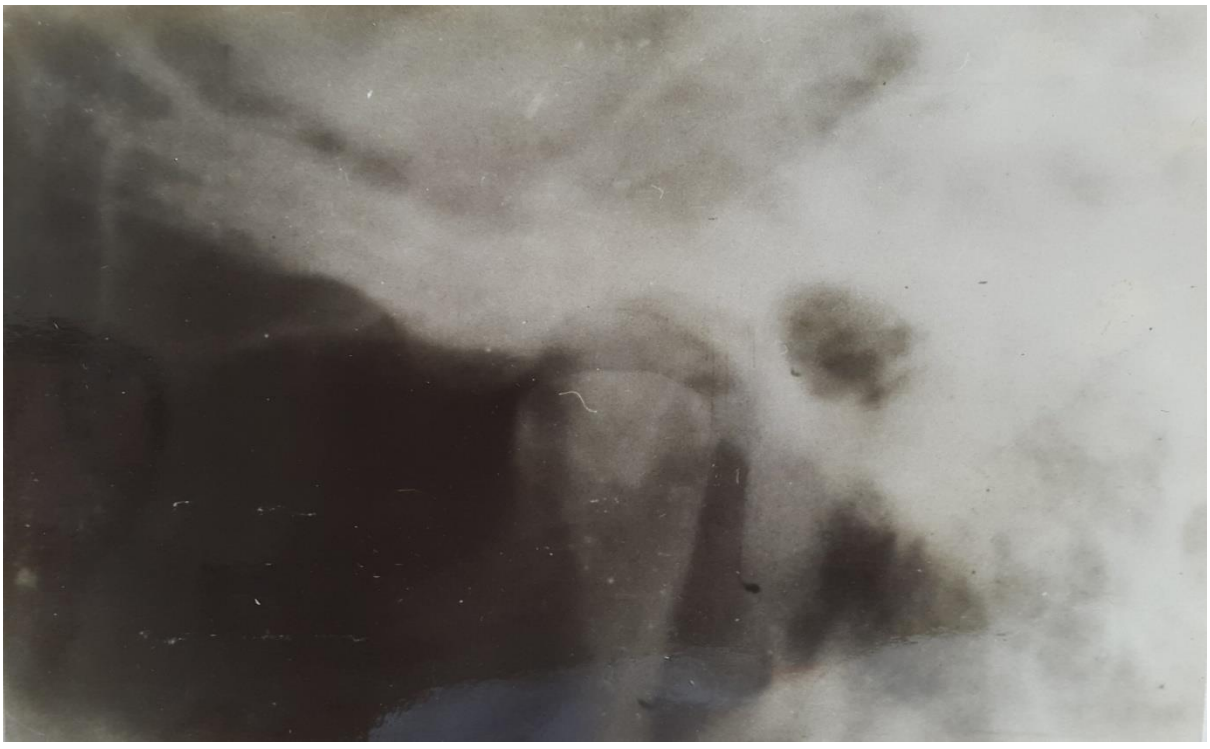


Fig .14. Radiograph of left side condyle after wax check bite record

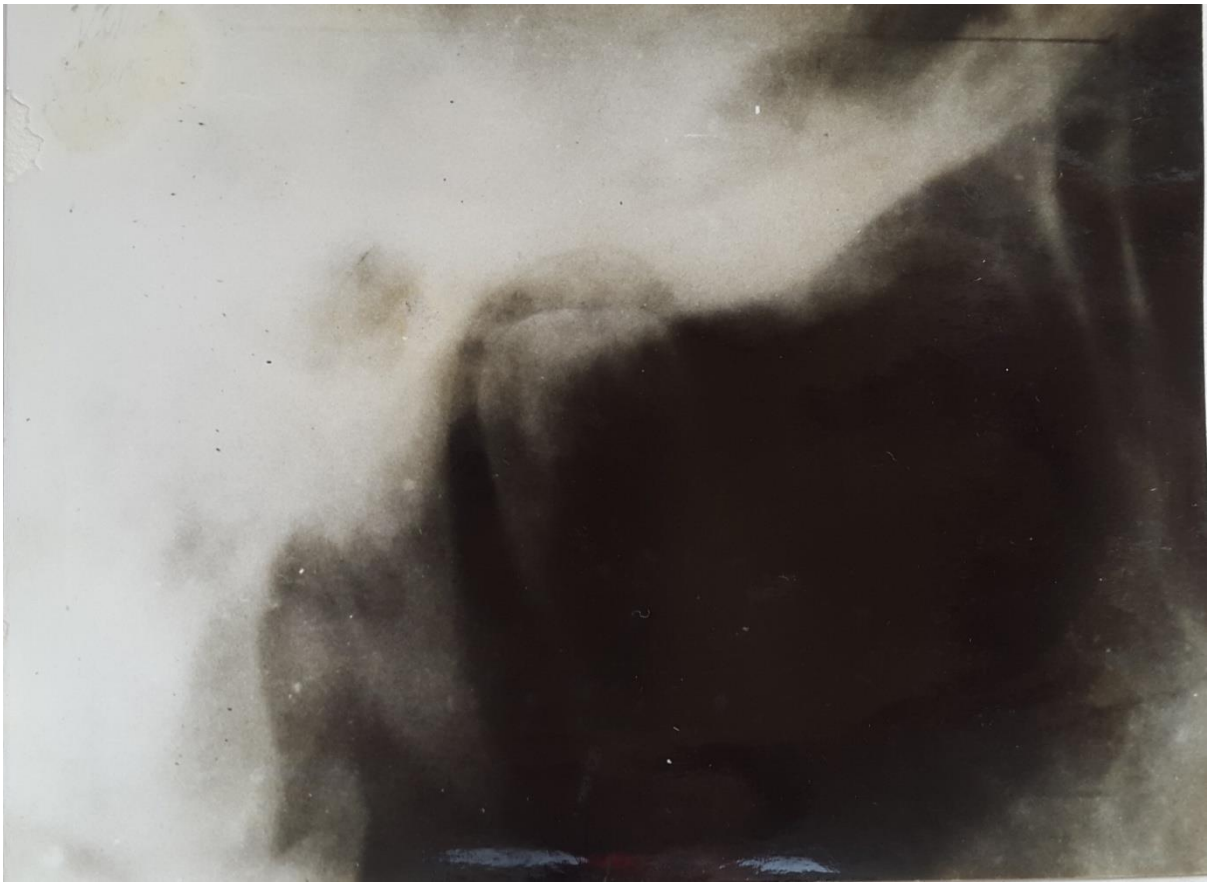


Fig .15.Radiograph of right side condyle after Gothic arch tracing.

Fig. 16.Radiograph of left side of condyle after Gothic arch tracing

Fig .17. Radiograph of right side condyle after denture insertion

Fig .18. Radiograph of left side condyle after denture insertion

In the present study, the position of condyle was determined in wax check bite record, Gothic arch tracing and post insertion of denture by radiographic means. Ten edentulous male patients were selected for the purpose of study.

To find the significance between change in position of condyles, distance between points S-SI, P-PI and A-AI in wax check bite records, Gothic arch tracking and after denture insertion was subjected to statistical analysis.

The observation are of quantitative type and the sample size is 10 i.e. less than 30. So the test of significance applied

was unpaired student's 't' test.

The formulae that were used are -

$$1.S.D = \sqrt{\frac{(x-x)^2}{n-1}}$$

$$2.SE = \sqrt{\frac{E1^2 + E2^2}{n1\ \ n2}}$$

Degree of freedom = n1 + n2-2

Probability Value = To be calculated from the't' table.

$$t = \frac{Difference\ between\ two\ means}{SE\ of\ difference\ between\ two\ means}$$

Table No.8.Shows the significance of each vale in percentage.

The S-S1 value of 't' test in all the cases was insignificant i.e. no significant change in the superoinferior position of condyle from TJR to GAT, from GAT to DD and from TJR to DD at both the right and left side was observed.

The P-P1 values from TJR to GAT on the right side was significant by 0.05% and on left side by 0.03%. From GAT to DD stage the values were significant by 0.02% on the right side and 0.01% on the left side. From the TJR to DD stage, the value were significant by 0.07% on right side and 0.05% on the left side.

The A-A1 values from the TJR to GAT were significant 0.03% on the right side and 0.02% on the left side. From GAT to DD they were significant by 0.02% on both the sides. From TJR to DD the values were 0.05% on both the sides.

The bar diagram showing the mean values at the three stages, shows position of condyle in different positions at different stages and thus significantly changed,

The condyle does not change its position significantly superoinferiorly but changes significantly from TJR to GAT. At GAT it goes posteriorly. From GAT to DD it comes anterior to the position of condyle at GAT.

From TJR to DD, change is by 0.07% of the right side and by 0.05% on the left side was observed. This is greater than the change in position at TJR to GAT and GAT to DD.

It shows that the position of condyle is posterior most in gothic arch tracing, anterior most in the wax check bite record. The position of condyle was anterior to GAT and posterior to TJR after denture insertion.

CONCLUSION

In the study the TMJ radiographs were used for correlating the findings of the position of condyle at various stages. TMJ radiographs made using the head positioner provide a valuable adjunct to diagnosis and treatment planning in determining the position of condyle at centric relation and centric occlusion. Findings showed that there existed unequal joint space between the head of condyle and the glenoid fossa at various stages of denture.

a) Position of condyle in wax check bite record was found anterior to the position of condyle in Gothic arch tracing.
b) Position of condyle was found posterior after denture insertion so that the position of condyle in wax check bite record.

c) Position of condyle was anterior most in the wax check bite record and posterior most in the Gothic arch tracing.
d) The position of condyle after 7 days of recall was near to Gothic arch tracing.
e) Subjective evaluation was done by direct questioning to check for comfort and it was found comfortable after 7 days recall after denture delivery.

ABBREVIATION

S- Superior reference point on the glenoid fossa.
S1- Superior point on the condyle
P - Posterior reference point on the condyle
P1- Posterior point on the condyle
A - Anterior reference point on the glenoid fossa.
A1- Anterior point on the condyle
TJR - Tentative jaw Relation
GAT- Gothic Arch Tracing
DD- Denture Delivary.

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