THE INCIDENCE OF POSTERIOR CROSS-BITE IN ADULTS

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INTRODUCTION

The necessity for a comprehensive and accurate diagnosis in preparation for treatment planning has never been more important in any of the clinical specialties than in orthodontics. In many instances the orthodontic result, as well as the retentive capacity of the treated dentition, is largely a reflection of the thoroughness and accuracy with which the clinician diagnosed the orthodontic problem.

Every malocclusion had some unfavorable characteristics that produced the dental irregularity. The number of these unfavorable factors assembled in the same patient and their interrelationship with each other apparently determined the possibility for success in treatment or had inherent factors which made the outcome of treatment questionable. This encompassed a number of different entities, i.e., the skeletal, the dental, and the muscular, among others.

Many variations characterized the face in which is the orthodontist's task to improve the anatomical relationships of the teeth and alveolar processes. The complexity of these compounded the problem.

The posterior cross-bite is a condition which may appear in all of the three stages of dentition: 1) deciduous, 2) mixed, and 3) permanent.

In investigations of the frequency of posterior cross-bites in deciduous and mixed dentition, Kelly[21] reported on a study of 7,417 children, which was representative of approximately 23.8 million non-institutionalized U.S. children aged 6-11, an incidence of 8% of the children with posterior cross-bites. In another investigation, Kelly[22] reported a frequency of 12% with posterior cross-bite based on 7,514 youths representative of approximately 22.7 million non-institutionalized U.S. youths aged 12-17.

Kutin[24] found in a study of 515 children 3 to 9 years of age that forty have posterior cross-bite in the deciduous or mixed dentition, for an overall prevalence of 1:13 or 7.7%.

Telle[37] found cross-bite in as many as 155 (7%) of 2,349 school children.

The purpose of the present study is to estimate the incidence of posterior cross-bites in the permanent dentition.

REVIEW OF THE LITERATURE

Cross-bite, according to Wood[44], is an abnormal buccal, labial, or lingual relationship of a tooth or teeth of the maxilla, the mandible, or both when the teeth of the two arches are in occlusion. It may include one or more teeth, and it may be unilateral or bilateral.

A report presented by the Burlington Group at the University of Michigan Workshop in orthodontics[44] stated that posterior cross-bites appear at a fairly constant rate in Class I and Class II malocclusions in the age groups of 3, 6, 8, 10, and 12 years which suggests that this defect develops early and is not self-correcting.

Moyers[32] classifies cross-bites as dental, muscular, or osseous. According to his definitions, dental cross-bites involve only tipping of teeth. The condition is localized in the alveolar process and does not affect the size or shape of basal bone. In this group the upper and lower midlines will coincide when the jaws are apart and diverge as teeth come into occlusion. On the other hand, the muscular type involves muscular adjustment to tooth interference. According to Moyers, this muscular type is similar to the dental type except that the teeth are not tipped within the alveolus. In the dental type of cross-bite teeth must be moved, whereas in the muscular type occlusal equilibration, which permits changes in muscular reflexes governing mandibular positioning, may suffice for correction. Moyers includes in the osseous category the cross-disharmonies of the craniofacial skeleton. There may be asymmetrical growth of the maxilla or mandible or a lack of agreement of their widths. Moyers concludes that lack of harmony between maxillary and mandibular widths usually is due to a bilaterally contracted maxilla, in which case the muscles shift the mandible to one side to acquire sufficient occlusal contact for mastication and comfort. If deviation occurs just before the teeth make contact, it might be that a tooth interference was the original etiologic factor. If deviation increases throughout opening, the primary fault is likely to asymmetry of bony growth.

Some of the suggested etiologic factors in cross-bite include prolonged retention of deciduous teeth, crowding, premature loss of deciduous teeth, palatal cleft, thumb-sucking, abnormal action of the tongue, and arch deficiencies.

The causes of posterior cross-bite are varied and many authors are not in agreement.

Logan and Kronfeld[29] have shown in early infancy that the permanent buds are found occlusally and lingually to the developing primary dentition. Soon after birth these permanent buds migrate to a lingual position in relation to the primary teeth and assume a location more nearly apically to them. Gainsforth[13] thinks that some factors which prevent this complete alteration of position may cause the permanent teeth to erupt lingually to the primary teeth which preceded them. If eruption progresses far enough to lock the incisal edge of the opposing tooth before this migration takes place, a locked tooth, or cross-bite may occur. Gainsforth states that cross-bite may be produced by a prolonged retention of primary teeth which causes the succeeding permanent teeth to erupt lingually to their proper positions in the arch. Occasionally the resorption of a primary tooth is slow or incomplete and deflection of the permanent successor results. The erupting tooth takes the path of least resistance and erupts in an abnormal position.

Frequently children may be observed in whom the primary incisors do not appear to have sufficient space for correct alignment. Anterior crowding of the mandibular incisors, coupled with unjustified extraction, may cause a collapse of the lower arch and complete lingual positioning of one or more of the premolars. A similar situation in the maxilla will result in a more typical cross-bite, one in which one or more maxillary teeth occlude at least one cusp lingually to the mandibular teeth. Disharmonies in size of teeth and length of arch in the maxilla frequently cause lingually positioned incisors. When the stress of the crowding is not absorbed in the anterior region the bicuspids may buckle and assume a lingual version.

The palatal cleft with a cleft of the lip usually is accompanied by a severe cross-bite. In this instance there is a deficiency of the bony structure needed to oppose the natural muscular forces exerted upon the buccal surfaces of the teeth by lip and cheek. Since all teeth are "floating" within a balance of forces, this disruption is more than enough to produce a severe deformity. Treatment is difficult in the child with a palatal cleft since the scar tissue, present as a result of surgical closure, limits orthodontic movement.

Thompson[38] concludes that thumb-sucking may be an etiologic factor in cross-bite. It may cause a symmetrical narrowing of the maxillary arch and in order to occlude the maxillary teeth with the normal mandibular denture, the mandible must shift to the right or left and the teeth occlude in a cross-bite.

Porter[34] confirms this in his study and states: "When the frequency of children, observed to have cross-bites of the teeth of the buccal segment, both posterior and canines on the same side, was used as a point of comparison to those without this trait, those children with histories of digital sucking had a greater frequency of the trait than their counterparts. This crossbite of the buccal segment, seen in those with past histories, strengthened with the increase in the duration of the sucking."

Higley[17] states that postural force produced on the dento-facial area by sleeping on the stomach during childhood may tend to narrow the dentoalveolar structures of the maxilla, resulting in a maxillary arch that is narrower than the mandibular arch. Consequently, Higley states, "The patient is forced to swing the mandible to either left or right in order to complete closure and to aid in masticatory efficiency. If the lateral shift persists, a morphologic change in the mandible may be produced." Higley uses a test similar to Moyers for differential diagnosis of posterior cross-bite. In Higley's test, which is employed when the midlines do not coincide in centric occlusion, the patient is asked to open the mouth slowly. If the mandible swings back to and continues to open in the midline, the cause may be tooth interference, joint disease of the tumor type, arthritis, or a foreign object in the glenoid cavity that causes deflection only in the closed position. If the mandible deviates further on opening, the most likely cause is joint disease of the ankylosis type. In this instance, the mandible swings toward the ankylosed side.

According to Brauer[3] the most common form of cross-bite is produced by interference of teeth. The maxillary and the mandibular dental arches may not be of equal width and therefore cannot close in a centric relationship because of cuspal interference, or in extreme cases, without the narrower arch closing completely lingually to the wider arch.

Quite often, just a few teeth, or even a single unit, may be malaligned or sufficiently over-erupted to make it necessary for the child to swing his mandible forward, or to one side in order to bring the teeth into occlusal contact. Such an abnormal position, assumed by the mandible to permit complete closure or improved masticatory function, often is called a convenience bite.

Such mandibular aberrations can be of etiologic significance in disturbances of the temporomandibular joint and the functional mandibular displacements may be responsible for loss of condylar growth which alters mandibular length.

According to Thompson[38], in premature contact of teeth whether it be in occlusion or in articulation or in both, the teeth are thrust aside slightly as the teeth occlude and as the mandible moves in function.

The tooth interference may be pronounced than premature contact and the mandible may be deflected from its normal functional path; now more than the teeth and supporting tissues are involved and the abnormal function may extend into the temporomandibular joints and musculature. Normally the condyle and disc glide as a unit on the articular eminence and it is the form of the eminence that determines the condylar path. The teeth are arranged to permit firm contact of the condyle and disc against the eminence during all functional movements of the mandible. When the tooth interference is such that this contact cannot be maintained, the condyle is moved away from the disc and the articular eminence so that an abnormal functional condition exists for which there is very little if any adaptation or compensation. The disc is held in its normal functioning relation to the eminence by the superior head of the external pterygoid muscle. The condyle, on the other hand, is directed by the occlusal interference and the normal tight attachment of the disc to the condyle becomes flacid thus permitting discoordinated rather than simultaneous movement of these structures. While the temporomandibular joints have a range of tolerance, they are quite precise in their complex functional movements. The amount of tolerance is one of the variations in function that exists between individuals just as there are variations in morphology.

Finally, the tooth interference may be so severe that the neuromuscular mechanism that positions and moves the mandible may direct the mandible to an abnormal occlusal position in order to avoid the interferences. This is called mandibular displacement and again abnormal function of the joints and musculature may result. In function the mandible moves directly into the position of displacement and it is not just a mechanical "hitting and sliding" situation.

The symptoms of abnormal temporomandibular joint function include clicking or crepitus, pain, irregular mandibular movement, subluxation, and strain and tiredness in the mandibular musculature. These may be present in various combinations of symptons and they vary in severity and frequency of occurrence; again, there is individual variation in tolerance.

Perry[33] in a cinematographic examination of masticatory patterns in 320 children recently revealed that buccal cross-bites were the most frequent cause of irregular chewing strokes. The researcher believed that this incoordination could suggest a relationship to TMJ dysfunction.

According to Horowitz and Hixon[18], not infrequently, erupting opposing teeth approach each other in such a way that only their prominences, or cusp tips, meet when the mandible is elevated in its centric relation path. When heavy chewing forces are used, this creates nociceptive stimulation to the teeth and supporting structures because the forces are concentrated and not well distributed. This results in activation of protective reflexes that move the mandible into a position of greater comfort and stability and it is the genesis of the clinical entities called mandibular shift, false centric, and dual bite.

An eccentric mandibular position will persist as long as the occlusal disharmony that produced it is still present. When it occurs during the development of the dentition, this type of aberration may unfavorably affect the remainder of the developing occlusion. This is true because teeth erupting subsequently may be guided into cuspal interdigitation with the mandible displaced in eccentric relation to the maxilla.

Werther[39] states that the tongue may cause an excessive width of the mandible and thus carry the lower molars buccal to the upper molars. In the maxilla by incorrect positioning in the palatal area it may result in an abnormal expansion and force the upper molars into an improper buccal relationship with the lowers. According to Werther[39] when the paths of eruption of the maxillary and mandibular first permanent molars are examined, it is readily discernible, that if the rate of vertical eruption and buccal or lingual movements are not coordinated, a cross-bite may also occur. The path of the erupting upper tooth is toward the distal and buccal and during eruption it must turn in a mesial direction. The lower, in contrast, moves toward the mesial and lingual and upon eruption turns toward the distal and buccal. Any interference with this series of developmental movements during eruption may result in a cross-bite.

Axial inclination, as defined by Hemley[16], refers to the inclination of the long axis of the tooth. It actually describes the relationship of the crown of the tooth to its apex. The characteristic anatomic cuspal relationship and inclination of the permanent molars causes the upper teeth to have a buccal-axial inclination, and the lowers usually a lingual-axial inclination.

In normal axial inclinations forces are readily transmitted in the long axis of the tooth, that is, in a vertical direction. One of the very important reasons why most posterior cross-bites require correction is that in many of these cases the forces are much more lateral in direction. This is potentially more destructive. Some periodontists[39] feel that the direction which a food bolus takes during mastication in a mouth with a posterior cross-bite may be conducive to a periodontal disturbance by causing gingival irritation.

Clinch[9] stated that the anatomic shapes of the teeth help to guide them into their correct occlusion. She stated, for example, that the distal two-thirds of the occlusal surface of the lower first permanent molar has a large steep-sided fossa and that when the most prominent point of the upper molar, the large mesiolingual cusp, engages this fossa, the two features direct the molars into normal occlusion. Thus, she believes that aberrations in tooth anatomy or eruption sequence also may cause a cross-bite to develop.

In the treatment of maxillary deficiency by opening the midpalatal suture, Haas[15] differentiates between real and relative maxillary deficiency. Relative maxillary deficiency occurs when the maxilla is of expected size as compared with the upper face and cranium but the mandible is disproportionately large. In real maxillary deficiency, there exists a compression of the maxilla with constriction of the buccal tooth segments. The teeth may be upright over the base but most often they are inclined buccally, as if reaching to occlude with the mandible. The labial and buccal musculatures rarely permit permanent lateral tipping of maxillary teeth, while the tongue rarely tolerates the confining aspects of a contracted mandibular arch. Therefore, Haas suggests one should try to correct the disparity in denture-base width rather than in dental arch width. For this reason, he recommends the use of rapid-acting palatal expansion appliances to expand arches rather than slow-acting removable appliances which, he believes, tip teeth.

In a report on rapid palatal expansion, Wertz[40] advises that a differentiation must be made between a true unilateral cross-bite in which the midlines coincide and which usually should be treated only unilaterally and a unilateral cross-bite due to lateral mandibular displacement which, distal two-thirds of the occlusal surface of the lower first permanent molar has a large steep-sided fossa and that when the most prominent point of the upper molar, the large mesiolingual cusp, engages this fossa, the two features direct the molars into normal occlusion. Thus, she believes that aberrations in tooth anatomy or eruption sequence also may cause a cross-bite to develop.

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Movement of deciduous molars can affect the erupted position of the premolars, as shown by Mathews[31] in an article describing translational movement of the first deciduous molar. Mathews found that distal movement of a deciduous molar is followed by distal movement of its unerupted successor. He observed that the unerupted premolar followed the banded deciduous molar distally and erupted in a position distal to its original position. He did not consider whether this same type of effect follows buccal or lingual movements of deciduous molars, as in posterior cross-bite correction.

In summary, it appears that the etiology of posterior cross-bites in the permanent dentition is of a multifactorial and complex nature.

MATERIALS AND METHODS

The prevalence of cross-bite was examined in the permanent dentitions of 334 adults (210 females, 124 males) in the Operative Clinic of the University of Oregon Health Sciences Center, School of Dentistry. The adults are believed to be a lower socioeconomic group.

The examination and diagnostic technique employed in this study began with observing the patient as he closed and then opened the mouth to determine deviations of the mandible. If the patient was not closing properly, the mandible was guided gently into what appeared to be his centric occlusion. In this position, the posterior occlusion was observed to determine whether or not cross-bite existed; whether it was unilateral or bilateral; which teeth were involved in the cross-bite; and whether maxillary teeth were in buccal or lingual relationship. The determination of which teeth or tooth were in malposition or cross-bite was made by reference to other teeth in the same arch, i.e., by assessing individual tooth deviations from the "line of occlusion". These observations plus if the patient had or had not previous orthodontic treatment were noted on a separate record for each subject as shown in Fig. 1.

FINDINGS

In this study 334 adults (210 females and 124 males) were examined for posterior cross-bite. Twenty-nine cases of posterior cross-bite involving one or more teeth were found. Of these twenty-nine cases, twenty were in females and nine were in males.

It was found that 8.68% of the adults or one in every eleven and a half adults, had some form of posterior cross-bite.

Table I shows the prevalence, by sex, of the posterior cross-bite.

In order to determine if there was a statistically significant difference in frequency of posterior cross-bite in males and in females, the data was subjected to a non-parametric test: the Chi Square (X^2) with typically Yate's correction. It was found (Table IIA, IIB, and III) a Chi Square value of .035. This value was confirmed using another formula for Chi Square (1.1).

The critical value with df=1 was found for Alpha of .05 to be 3.841.

Since the computed value did not exceed the table value for the chosen Alpha level, the null hypothesis was accepted that there were no statistically significant differences in frequency of posterior cross-bites between males and females.

It was found that nine adults or 2.7% had previous orthodontic treatment. Of these nine adults, eight were females and one was male, all of these nine adults were without posterior cross-bite.

Of the twenty-nine cases of posterior cross-bite, ten or 24% showed some kind of shift of the mandible. The shift was detected in eight females and two males. Three females had anteroposterior shift and five had lateral shift of the mandible. The two males had anteroposterior shift of the mandible.

Table IV shows the distribution of posterior cross-bite observed in both females and males and it was concluded that eight or 28% of the twenty-nine adults with posterior cross-bite had a bilateral cross-bite and twenty-one or 72% had unilateral cross-bite. Of the eight bilateral posterior cross-bites, it was observed that six were females and two were males. Of the twenty-one unilateral posterior cross-bites, it was found that fourteen were females and seven were males.

As shown in Table V it was observed that:

1. Ten adults presented one tooth in cross-bite.
2. Eight adults presented two teeth in cross-bite.
3. Four adults presented three teeth in cross-bite.
4. One adult presented four teeth in cross-bite.
5. Three adults presented five teeth in cross-bite.
6. Three adults presented six teeth in cross-bite.

Table V also shows the frequency for males and females separately. Fig. 2, Fig. 3, and Fig. 4 present the observations of Table V in a histogram form.

Table VI presents the frequency distribution of teeth in cross-bite. It was concluded that the tooth with a higher frequency was the upper right first molar with 14.3%. It was followed by the upper right second bicuspid with 13.0%; upper left first molar, upper left second bicuspid, and upper right first bicuspid with 11.7% each.

Table VI also presents the frequency for males and females separately.

DISCUSSION

From the results obtained in the examination of 334 adults, it was found that 8.68% or one in every eleven and a half adults, had some form of posterior cross-bite. This figure is high enough to warrant further investigation of posterior cross-bites and their treatment in early dentition phases.

Within the same dental arch, every single tooth is clearly related to every other tooth; and of no less significance, the members of one dental arch are clearly related to their opposite numbers in the other. Consequently, only one position is possibly ideal and suitable within the denture for each tooth. Forces inherent in the denture, commonly called the forces of occlusion, aid and direct the teeth in reaching their appropriate and final placement.

Historically balanced occlusion has been a main point of attention in orthodontic considerations. Balanced occlusion means a stable relationship between the teeth and their supporting bone.

There can be many types and combinations of asymmetrical development. Some types involve the deep-seated structures of the apical base areas. Others occur within the various portions of the dental arch. Still others result from differences in the size and shape of the arches in opposing jaws. Whenever these and other asymmetries occur the nature of the problem is likely to be individually peculiar.

Whenever we consider the influence of dentofacial asymmetries upon treatment procedures, care must be taken to differentiate between the real asymmetries involving deep-seated variations between supporting structures and the functional aysmmetries which result from local causes.

In the chapters on etiology of malocclusion it was stressed that abnormal growth and developmental patterns are apt to be a major basis for malocclusions. Such patterns are largely hereditary, but a normal developmental pattern may still be side-tracked by obstacles along the road toward the maturity of the stomatognathic system. Abnormal finger sucking habits, perverted perioral muscle function, premature loss, and similar factors may upset the timetable and cause morphologic and functional changes detrimental to the dentition.

Even though the narrowing of the maxillary arch is usually bilateral, the "convenience swing" is habitually to one side. Prolongation of this abnormal relationship can cause permanent changes in tooth position, in the bony support and possible in the temporomandibular joint growth center.

Each malposed deciduous tooth exerts an unfavorable influence on some of the permanent teeth. Postponement of treatment means that for several additional years all of the tissues associated with the jaws will be growing to those jaws which are in abnormal positions. Therefore, the necessary readjustment of such tissues during and after orthodontic treatment will be greater, will require more time, and the final results may not be entirely satisfactory.

Cross-bite conditions of the deciduous teeth are invariably followed by similar malocclusions in the permanent teeth with coincident facial development.

Prolonged cross-bite conditions also accentuate individual tooth malpositions so that asymmetry of the arch becomes a fact. In the initial stages, however, the upper arch can by quite symmetrical despite the cross-bite. The belief is widespread that unless these cross-bites are eliminated, not only will they lead to asymmetry of the dental arches, but an actual facial asymmetry results in the adult. Obviously, cross-bites should be eliminated whenever possible.

In some of them, however, judicious occlusal grinding is enough to eliminate the guiding force. Since a "high" tooth can cause a deflection of the mandible during closure, calling for certain proprioceptive responses and a learned pattern of activity, the elimination of the inciting factor breaks the proprioceptive pattern and permits re-education of the manifold associated forces toward a normal path of closure and centric relationship.

In assessing posterior occlusion, the midlines between the maxillary and mandibular incisors were used as a reference. In cases of unilateral posterior cross-bite in which the midlines did not coincide, the midlines were aligned normally and then the posterior occlusion was observed. When this was done and a cross-bite was still evident, it was almost always found to be bilateral, lending support to the hypothesis of a bilateral constriction of the maxilla. This slight constriction may have caused the occlusion to be unbalanced by tooth interference in centric occlusion. In order for the patient to arrive at a comfortable occlusion, the mandible is thrust to one side to alleviate the problem and an apparently unilateral posterior cross-bite is created. In many cases, the interfering tooth or teeth involved are the deciduous canines. On the other hand, unilateral posterior cross-bites with incisor midlines that are aligned, indicate a true unilateral posterior asymmetry principally on the basis of the importance attached to the dental midlines. The midline discrepancies are due to several factors in addition to mandibular displacement. Other factors determining the relationship of the incisor midlines include arch symmetry and asymmetry, the sequence of tooth eruption as well as tooth loss, and the discrepancy of tooth size, either within each arch or between the maxillary and mandibular arches. In other words, the midline between the opposing incisors is not an absolute indicator of the lateral position of the mandible with respect to the maxilla.

If follows, then, that an unknown number of the unilateral cross-bites with coinciding midlines may actually be bilateral posterior cross-bites with midlines in alignment only because of an aberration in one or more of these factors. Thus, all cases except those with obvious unilateral asymmetry should be treated bilaterally. Therefore, a differential diagnosis is extremely important before treatment is begun in cases in which the maxillary teeth are lingual to the mandibular teeth unilaterally.

Another important treatment consideration arises in cases involving combined cross-bites of anterior and posterior teeth or exhibiting a pseudo-Class III tendency. In both cases, because of the protruded position of the mandible in relationship to the maxilla, a wider portion of the mandibular arch occludes with a narrower portion of the maxilla and results in the cross-bite.

The posterior cross-bite treatment includes some of the following benefits: Establishment of the proper buccolingual relationship of all posterior teeth, normal lateral development of the maxillary arch, restoration of the normal temporomandibular joint function, correct cuspal interdigitation in centric position, and restoration of the facial balance. The achievement of these goals, as applicable, may be of great assistance in the correction of facial asymmetries.

SUMMARY AND CONCLUSIONS

In this study 334 adults (210 females and 124 males) were examined and twenty-nine were found to have posterior cross-bite in the permanent dentition, for an overall prevalence of 1:11.5 or 8.68%.

Each patient was subject to a clinical examination as he closed in centric relation. In this position, the posterior occlusion was observed to determine whether or not a cross-bite existed; whether it was unilateral or bilateral; and which teeth were involved in the cross-bite. These observations were noted on a separate record for each subject.

It appears that the etiology of posterior cross-bites in the permanent dentition is of multifactorial and complex nature.

The factors responsible for asymmetries in the dentofacial complex are not confined to the teeth and alveolar process. They may be found in the various component parts of the face and all the structures surrounding the teeth. It is the interplay of these local asymmetries with those originating from the deformation of the skull that is responsible for the infinite variation in the dentofacial complex and forms the basis for its morphologic and functional individuality.

It should be emphasized that a thorough diagnosis should precede orthodontic treatment, particularly, differentiation between a simple malposed tooth and aberrations of bone or temporomandibular joint. Cross-bites may be a part of a more complicated malocclusion. Retention is important in many instances to prevent relapse. It appears logical that early treatment is indicated for cross-bites, in view of the possibility that they may interfere with the proper development and growth of the jaws and cause progressive damage to the dental arches and temporomandibular joint or retardation of condylar growth.

The diagnosis of unilateral and bilateral cross-bite remains largely empirical in the absence of reliable reference points for determining the correct lateral position of the mandible. The use of interincisal mid-lines for this purpose is questioned.

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TABLE I

Prevalence of Posterior Cross-bite.

Sex	Number Examined	Number with Posterior Cross-bite	Percentage	Prevalence Ratio
Female	210	20	9.52	1:10.5
Male	124	9	7.26	1:14
Total	334	29	8.68	1:11.5

TABLE IIA

General Format for Two by Two Table

A	B	J
C	D	K
L	M	N

Where in this specific case

A = Number of females with posterior cross-bite
B = Number of females without posterior cross-bite
C = Number of males with posterior cross-bite
D = Number of males without posterior cross-bite
J = Number of total females
K = Number of total males
L = Number of adults with posterior cross-bite
M = Number of adults without posterior cross-bite
N = Total number of adults

TABLE IIB

Two by Two Table of Males and Females with and without Posterior Cross-bite using the Values of Table I in Table IIA.

20	190	210
9	115	124
29	305	334

TABLE III

Chi Square for Posterior Cross-bite in Adults

O Observed	E Expected	O-E	$(\lvert O-E \rvert - .5)^2$	$\frac{(\lvert O-E \rvert - .5)^2}{E}$
20	$\frac{29 \times 210}{334} = 18$	2	2.25	0.12
9	$\frac{29 \times 124}{334} = 11$	-2	2.25	0.20
120	$\frac{305 \times 210}{334} = 192$	-2	2.25	0.01
115	$\frac{305 \times 124}{334} = 113$	2	2.25	0.02
				$0.35 = X^2$

$$X^2 = \frac{N(\lvert AD - BC \rvert - .5)^2}{JKLM} \qquad (1.1)$$

TABLE IV

Distribution of Posterior Cross-bite

		Females	Males	Total	Percentage
Cross-bite	Bilateral	6	2	8	28
	Unilateral	14	7	21	72

TABLE V

Frequency Distribution of Posterior Cross-bites

	Males	Females	Total
Adults with one tooth in cross-bite	6	4	10
Adults with two teeth in cross-bite	1	7	8
Adults with three teeth in cross-bite	-	4	4
Adults with four teeth in cross-bite	-	1	1
Adults with five teeth in cross-bite	-	3	3
Adults with six teeth in cross-bite	2	1	3

TABLE VI

Frequency Distribution of Teeth in Cross-bite

Tooth	# of Teeth in Cross-bite in Males	# of Teeth in Cross-bite in Females	Total of Teeth in Cross-bite	Percentage
1	-	-	-	-
2	2	1	3	3.9
3	4	7	11	14.3
4	4	6	10	13.0
5	3	6	9	11.7
6	-	-	-	-
11	-	-	-	-
12	2	3	5	6.5
13	3	6	9	11.7
14	2	7	9	11.7
15	-	7	7	9.1
16	-	1	1	1.3
17	-	-	-	-
18	-	-	-	-
19	-	2	2	2.6
20	-	-	-	-
21	1	3	4	5.2
22	-	1	1	1.3
27	-	-	-	-
28	-	1	1	1.3
29	-	1	1	1.3
30	2	1	3	3.9
31	-	1	1	1.3
32	-	-	-	-
Total	23	54	77	

CROSS-BITE STUDY

1. Patient's name.

2. Orthodontic treatment or braces before? YES ________

NO ________

3. Teeth or tooth in cross bite

1 2 3 4 5 6 - - - - 11 12 13 14 15 16

32 31 30 29 28 27 - - - - 22 21 20 19 18 17

4. Does patient have a mandibular shift?

NO ____________

		mm
	Right	________
YES	Left	________
	Antero posterior	________

Fig. 1: Form in which posterior cross-bites were recorded for permanent dentition.

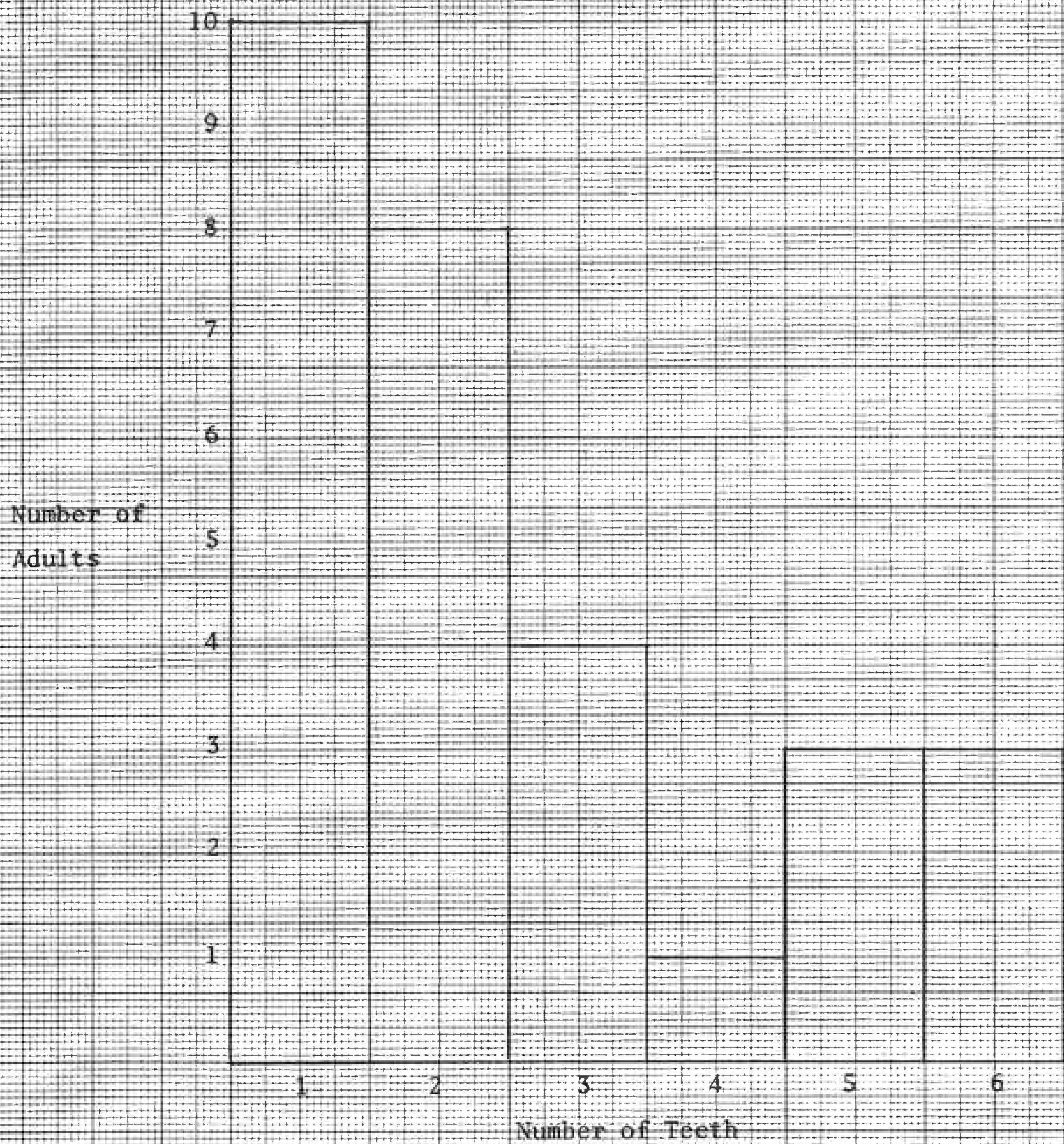

Fig. 2: Histogram of the number of affected teeth in individuals with crossbite plotted against the total crossbite population.

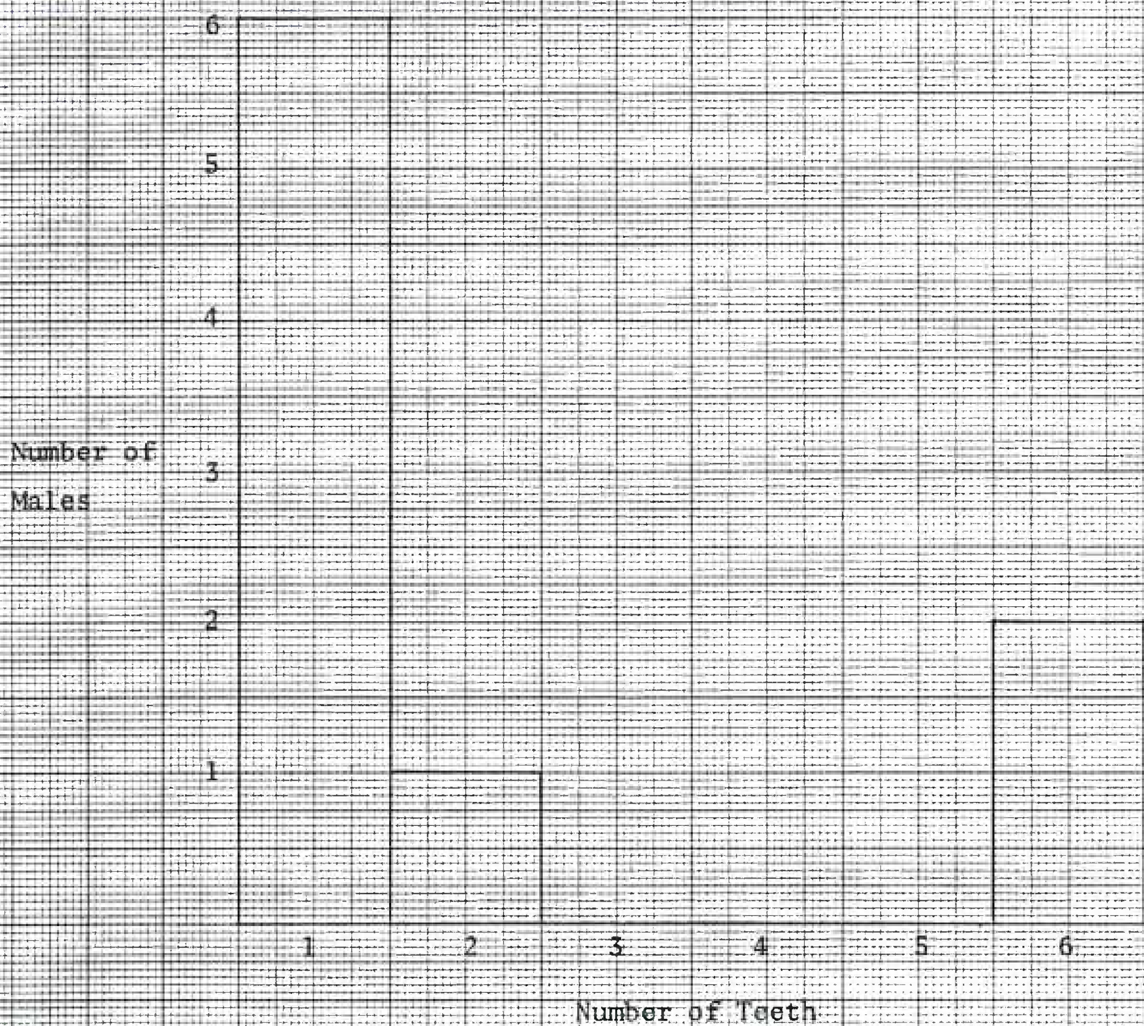

Fig. 3: Histogram of the number of affected teeth in males with crossbite plotted against the total male crossbite population.

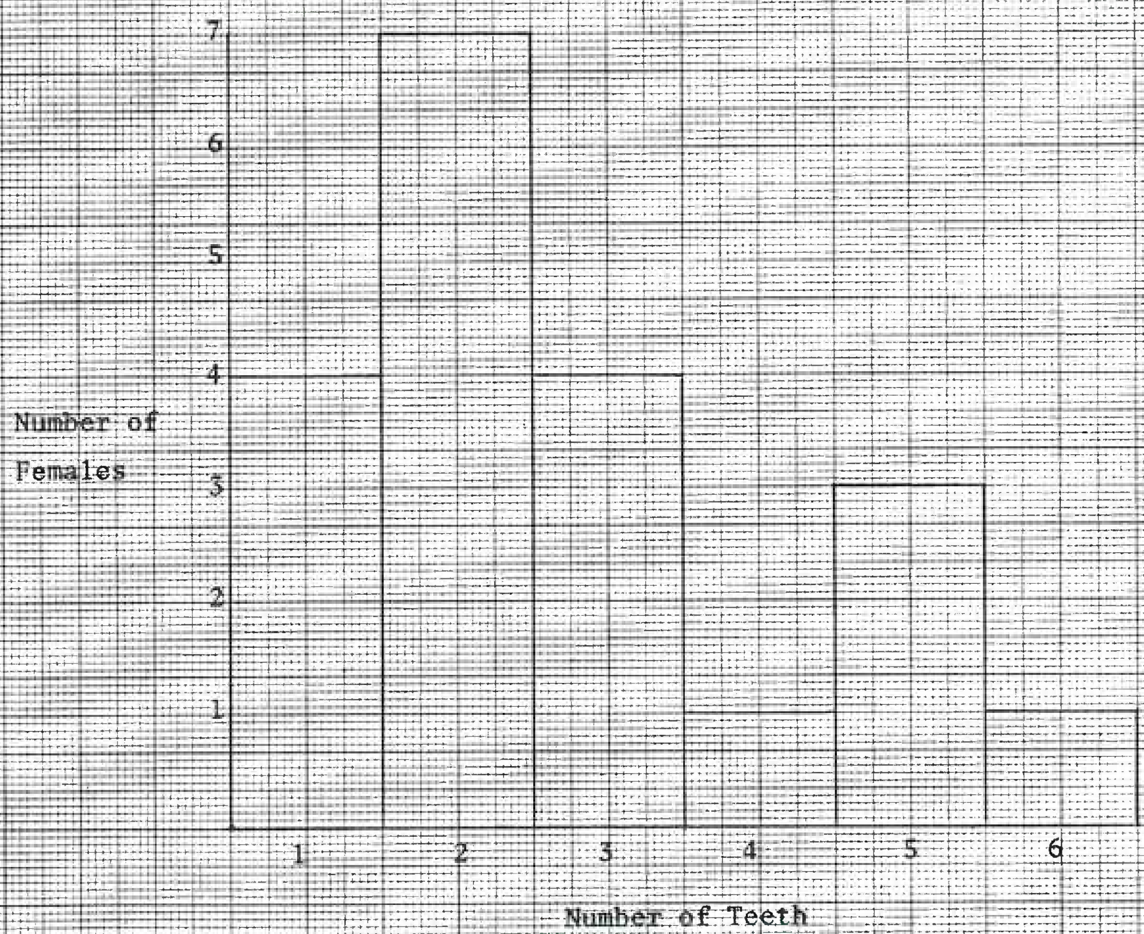

Fig. 4: Histogram of the number of affected teeth in females with crossbite plotted against the total female crossbite population.