CASE REPORT

Occlusal and functional evaluations in adults: A case report

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The findings on an adult patient with mandibular asymmetry and temporomandibular dysfunction are presented . The patient had four first premolars extracted earlier, followed by a short treatment attempt. Control of tongue function and jaw posture before, during, and after active treatment helped achieve a functional occlusion and a relief of the symptoms of the temporomandibular dysfunction. Specific diagnostic (assessment of occlusion and jaw movements) as well as therapeutic means (lower removable appliance and crown reshaping) are described. (Am J Orthod Dentofacial Orthop 1998;114:551-7)

Adults require careful screening for periodontal and articular conditions before orthodontic treatment. An additional functional assessment of the occlusal and gnathologic conditions is needed to establish an optimal orthodontic strategy. Two specific devices to gain this supplementary information, namely the Periotest (Table I) and the Sirognathograph (Table I)[1,2] may be used. Since 1982, 60% to 70% of the adult cases screened in our practice did not have detectable functional abnormalities. The remaining group, however, exhibited various dysfunctions potentially associating occlusion with the muscle and/or joint dysfunction. These findings when associated with pain and a high Helkimo index[3] may indicate the need for a temporomandibular joint (TMJ) therapy and adjustment of the occlusion. The required treatment may include orthopedic, orthodontic, and prosthetic regimens.

There are usually two main objectives in an adult treatment, namely, the least amount of intervention and a short treatment time to attain an esthetic and functional occlusion.

Correction should not, however, be restricted to one jaw or a single plane, ie, it has to be bimaxillary and three-dimensional in order to avoid potential side effects on the TMJ and muscles.

The difficulty in establishing a treatment plan, is related to the amount of jaw or tooth movement needed for the correction. As previously suggested,[4,5] the management of patients with temporomandibular dysfunction (TMD) should be reversible with the occlusal alteration, approximating as close as possible habitual occlusion. This initial step in the treatment is defined as "orthopedic" and includes muscle training and articular relief. When the patient is accustomed to the new functional posture, ie, with no discomfort or pain and a reduced Helkimo index, then additional orthodontic or prosthetic treatment may be undertaken.

Table I. Definition of terms

- The Periotest measures tooth mobility and occlusal overloading. It is based on the oscillation degree of the tooth when it is submitted to repeated strokes. In measuring the oscillation of the tooth in rest position and in maximum intercuspation, it is possible to assess the extent of the support or load provided by or resulting from the occlusion (ie, the opposite teeth) and thus, define the degree of overloading. The loading degree of each tooth helps to establish a map where maximal contact in centric occlusion occurs and consequently where chewing forces would be more susceptible to abnormalities
  (Siemens AG, Med Engineering Group, Fabrikstrasse 31 D-6140 Bensheim/Germany.)
- The Sirognathograph tracks jaw displacements in different tasks. Some are requested, like mouth opening and closure; others are recorded spontaneously, like chewing and speaking. Restricted or unrestricted jaw mobility will be handled differently according to the muscles involved and the risks of joint damage. (Siemens)
- The Helkimo index was introduced in 1989 in order to define the degree of CMD or TMJ dysfunction in a large population. Based on symptoms and signs related to the muscles and joints, the value is considered normal if < 5 and pathologically severe if > 20.
- The Tek-Scan appliance uses sensors in an occlusal sheath and a computer program to establish a mapping of the teeth coming in contact in maximum intercuspation. (Tekscan, Boston, Mass)

APPLIANCE DESCRIPTION

The most commonly used appliance for the "orthopedic" phase is a splint specifically, a Hawley retainer or other similar appliances, placed on the upper jaw to keep the mandible out of traumatic

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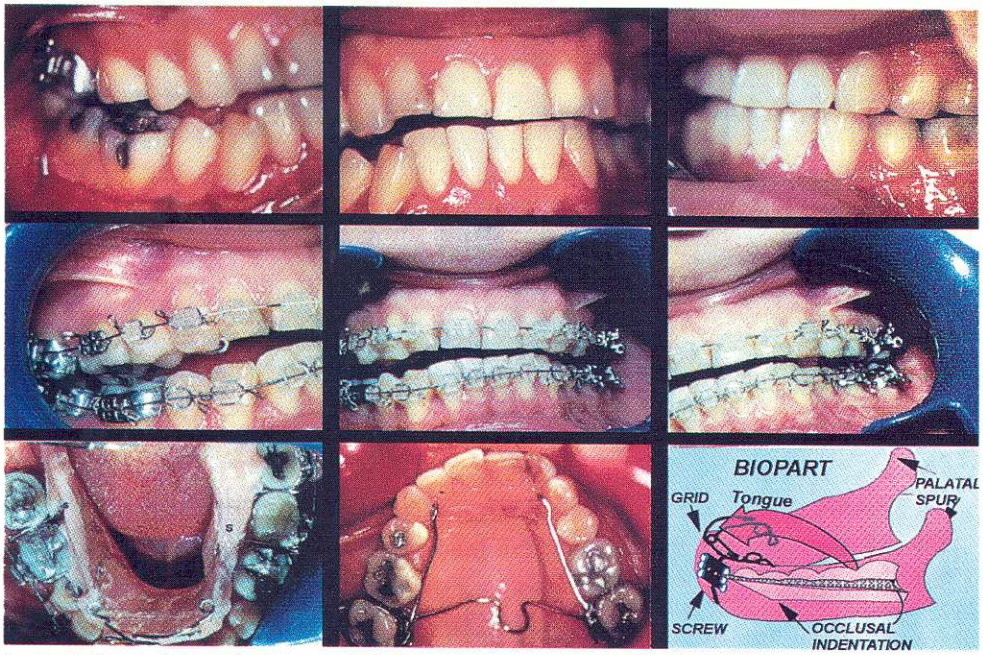


Fig 1. Intraoral views before and during treatment with Biopart (*G, I*) and crown reshaping of upper right molar and premolar (*H*). The Biopart displayed here is assumed to regulate dental perception and to contribute to tongue and lower jaw control during active treatment.

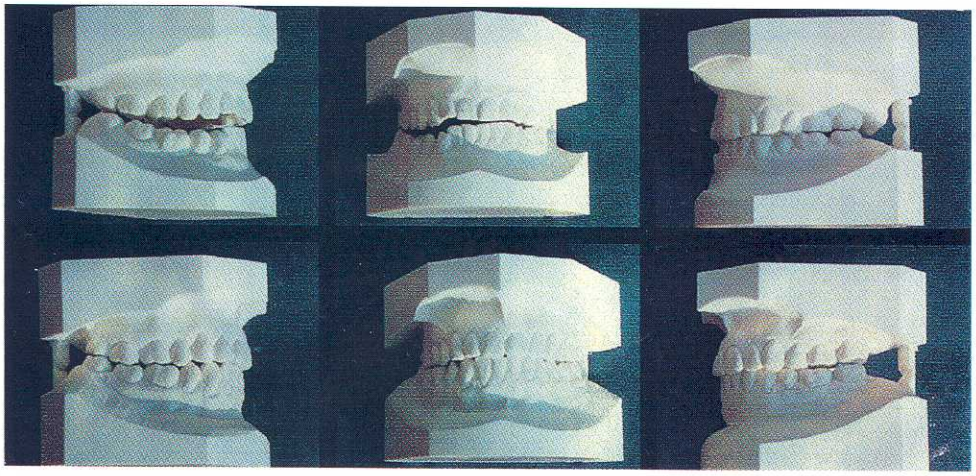
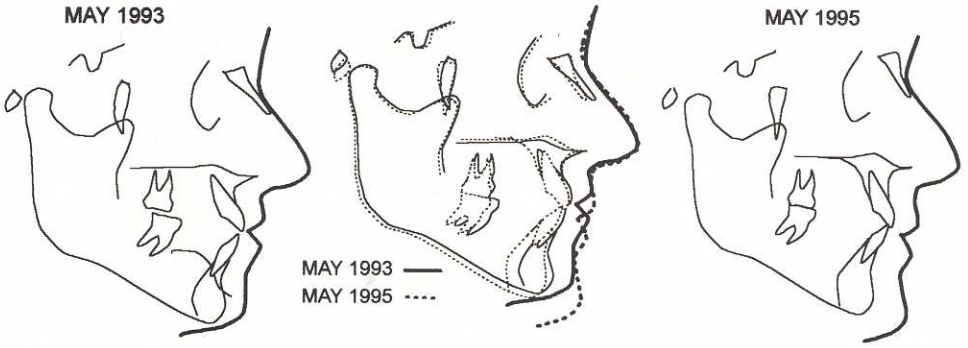


Fig 2. Initial and final dental study casts.

occlusion and help establish the resting posture for the muscles.[6]

Functional bimaxillary appliances such as the activator and the bionator are more efficient to train the muscular activity of the jaw and tongue. The activator trains the jaw muscles, and the bionator helps regulate the posture of the tongue. The Bioactivator[7] combines the advantages of both appliances and reduces the bulkiness enabling the patient to wear the appliance during daytime. Nevertheless, it is difficult to use concurrently with fixed appliances.

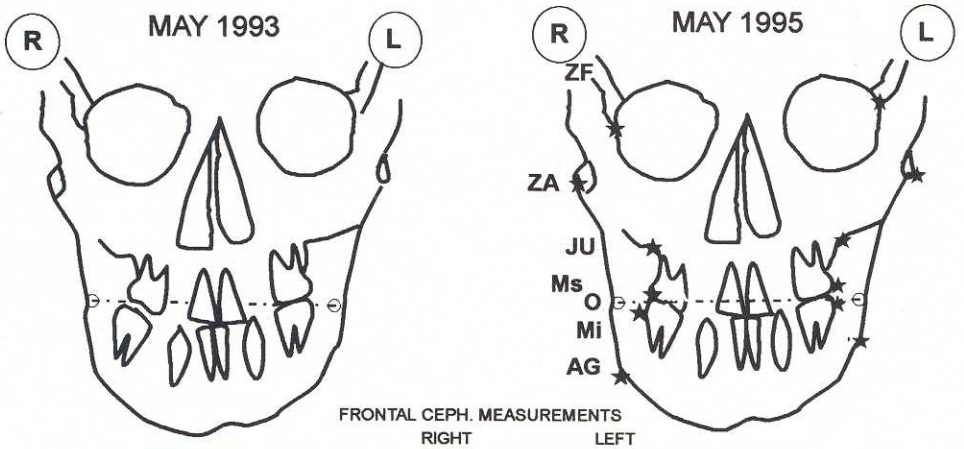
The Biopart (Fig 1*G*), which represents the lower and main part of the Bioactivator, has been used in this patient. It covers the lower lingual gingiva and extends to the upper palatal gingiva. The occlusal surfaces are trimmed or relined to obtain the most suitable (therapeutic) relationship of the lower jaw to the upper. Auxiliaries such as tongue grids and distalizing springs may be added to initiate or manage tooth displacement. The Biopart controls both tongue and jaw postures. It obtains the desired relationship between the dental arches, both physiologically through dental perception



LATERAL CEPH. MEASUREMENTS

	FACE			MAX.- MAND.			DENT.	
	MAY 1993	MAY 1995		MAY 1993	MAY 1995		MAY 1993	MAY 1995
FACIAL ANGLE	98.5°	94.0°	ANB	- 1.0°	2.0°	PTV-6 upper	19.0	17.5
FACIAL DEPTH	97.0°	94.0°	WITTS	- 4.5	1.0	PTV-6 lower	22.0	20.0
SNA	80.0°	81.0°	AB	0	4	i-NA	25.0	28.0
SNB	81.0°	79.0°	PTV-ANS	56.0	57.0	i-NB	19.0	26.0
LFH	37	42	PTV-PO	64.0	58.0	i-APO	1.0	2.0
			NL-ML	20.0	22.0			

Fig 3. Superimposed lateral cephalometric tracings before and after treatment.



FRONTAL CEPH. MEASUREMENTS

		RIGHT		LEFT	
HORIZONTAL	PARAMETER	MAY 1993	MAY 1995	MAY 1993	MAY 1995
ZYGOM.FRONTAL	ZF	51	50	50	51
ZYGOMATIC ARCH	ZA	64	63	62	65
JUGAL	JU	33	31	31	32
MOLAR SUP.	Ms	35	35	31	33
MOLAR INF.	Mi	37	35	31	33
ANTEGONION	AG	43	45	51	45
VERTICAL	PARAMETER	MAY 1993	MAY 1995	MAY 1993	MAY 1995
ZYGOM.FRONTAL	ZF	21	26	22	27
JUGAL	JU	50	53	50	54
OCCLUSAL	O	66	71	68	71
ANTEGONION	AG	96	100	85	92

Fig 4. Frontal cephalometric tracings, before and after treatment.

(ie, contact between specific tooth groups) and mechanically through its flanges and the trimmed or relined indentations of the cusps. Shaped to remain as thin as possible, it does not impede speech or prevent the use of brackets and bands.

The appliance is usually worn 10 to 15 hours a day, after an initial 2-week period of night wear. When the patient is symptomfree, the newly acquired position is maintained until the remainder of the orthodontic and prosthetic treatment is performed. To achieve this

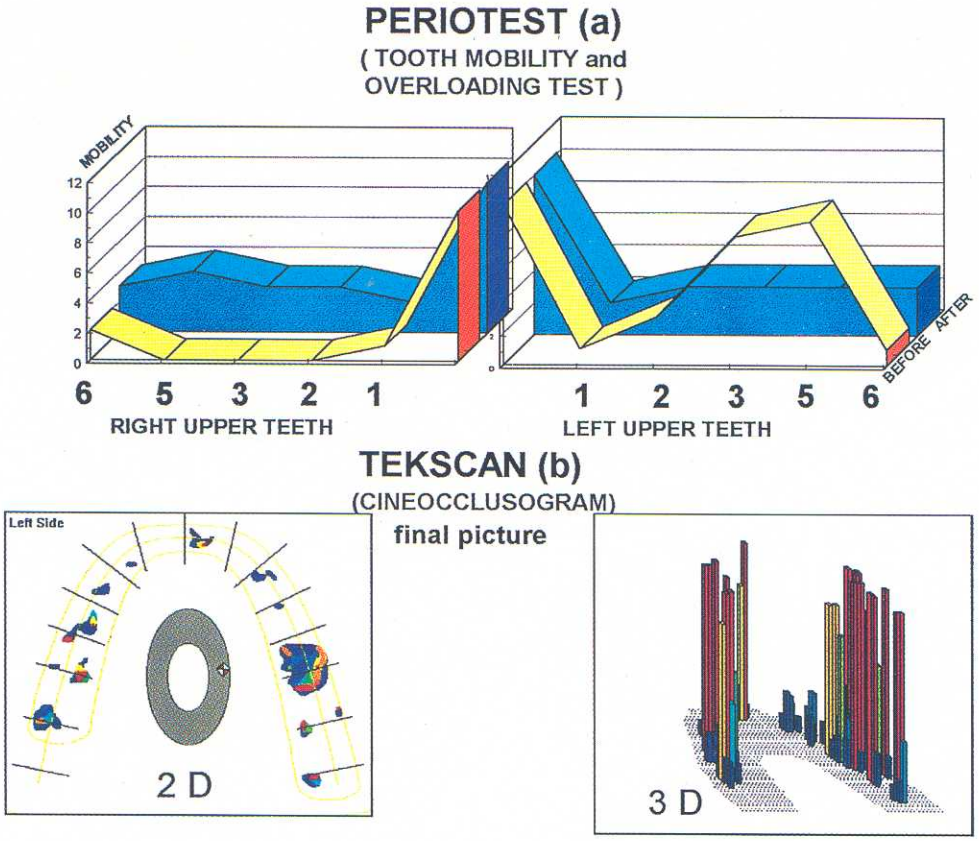


Fig 5. **A,** Periotest (tooth mobility and overloading test) shows the difference in tooth mobility between maximal intercuspation and rest position assessing the level of normal or abnormal overloading of the teeth in occlusion. The level of the difference before treatment is very high on the upper left canine and premolar and absent on the right counterparts (normal level, 3 to 4). **B,** Tekscan (cineocclusogram), a scanned movie of the maximum clenching in centric (habitual) occlusion with the final snapshot in two and three dimensions: the contacts are well scattered, with the center of the maximum force within the standard ellipses (68% and 95%). The intensity of the bite force applied on each tooth is disclosed in color, extending from the blue to the red one. It is also displayed in the height of the columns in the three-dimensional diagram. These results coincide with those of the Periotest.

objective, a crown remodeling procedure with restorative composite might be required. After etching and priming, the adhesive material (Silux/3M, Dental Products, 3M Healthcare Ltd, Loughborough, England) is applied on the occlusal surface of the canines in the Class II and of the molars in the Class III cases after its correction with the Bioactivator. The reshaping should establish tooth contact in a short centric occlusion with no sliding movement of the lower jaw.

CASE REPORT (FIG 1)

A 33-year-old woman presented in May 1993 with TMJ dysfunction. She had a history of four premolar extractions with no specific orthodontic treatment other than wearing a Hawley retainer for 1 year.

Clinical Examination

The patient exhibited a lower face asymmetry to the left side. The dentition was poorly restored and showed abraded cusps. The patient had bilateral mesial occlusion with a midline deviation to the right (Fig 1). Anterior and right lateral crossbite was evident. The patient was biting preferentially on the right but could also use the left side. The joint and muscle pains were bilateral but more on the left side.

Model Analysis (Fig 2)

The upper and lower first premolars were missing with the extraction spaces closed. The upper dental arch was constricted with the lower arch wider, particularly on the right side. Both arches exhibited some

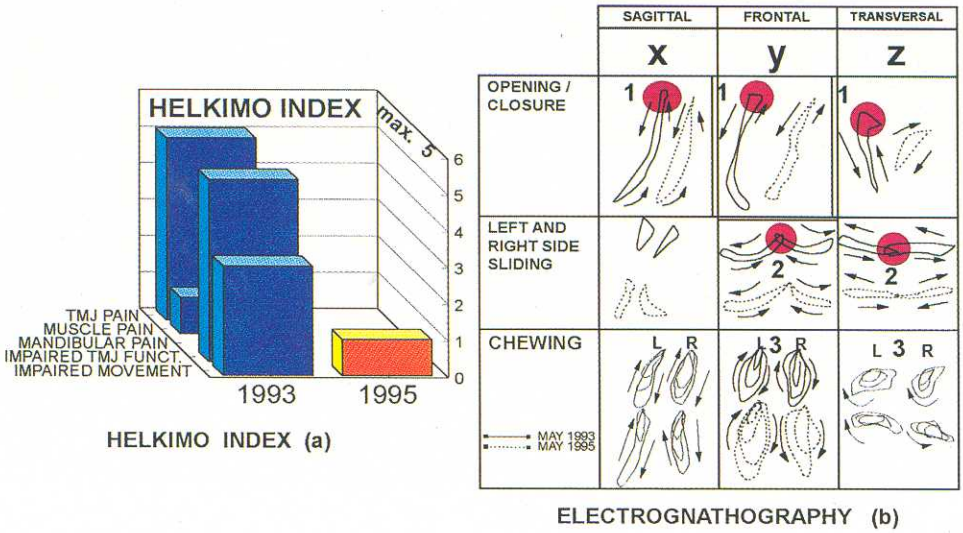


Fig 6. **A,** The Helkimo index defines clinically the severity of TMD. Each of the five groups of signs and symptoms can reach a maximal score of 5. The normal range is below 5. **B,** The Electrognathography, the three-dimensional jaw tracking pretreatment assessment of different tasks indicated: (1) a long centric (habitual) occlusion with no superimposition of initial and terminal points; (2) a midline overcrossing in the lateral displacements; (3) lack of mirror-like orientation, in the chewing strokes.

crowding. There was a complete right posterior cross bite with an open bite extending anteriorly. The Class III occlusion was more marked on the left side, with a midline shift of 3 mm to the right.

Radiographic Analysis

Numerous fillings were present, extraction spaces closed with little tipping of the neighboring teeth, and a missing lower left third molar. Crestal bone resorption was evident throughout the whole dentition especially in the molar region.

Cephalometric Findings (Figs 3 and 4)

The lateral cephalometric analysis revealed a brachyfacial type with prognathic tendency, mandibular skeletal protrusion, and proclined lower incisors. The AP cephalometric analysis showed symmetry of the upper craniofacial skeleton, an asymmetry of the upper and lower dentoalveolar arches with a lower midline shift to the right, and an upward and left side displacement of the chin and of the left mandibular angle.

Functional Analysis (Figs 5 and 6)

- The clinical symptoms of craniomandibular dysfunction were evaluated by means of the Helkimo index (0 to 25). Fig. 6*A* demonstrates an impairment degree of 13, which is significant.
- Tooth mobility and overloading (Periotest) are shown in Fig. 5*A*. The assessment of the difference in tooth mobility between maximum intercuspation and rest position indicated an excessive overloading of the upper left canine and premolar, before treatment.

Jaw tracking procedure (electrognathography) (Fig. 6B). The displacement of the mandible as tracked by the effect of the magnet glued between the lower central incisors indicated the following:

- For requested tasks such as opening, closing, and left and right sliding movements, the initial and terminal points of the tracks were not superimposed on any of the three planes. This indicated the presence of an unstable occlusion, and jaw movements, back and forth to habitual occlusion were not referable to a single maximum intercuspation.
- In spontaneous tasks like chewing, when the patient attempted to bite on both sides, the left and right strokes were not a mirror image. In a normal physiologic masticatory act, chewing alternates on both sides and shows reversed orientation of the cycles.

RESULTS (Figs 7 and 8)

To correct the malocclusion and the midline shift the following treatment was rendered.

- A biopart appliance was worn at night for 18 months (initially for a few weeks, day and night) in order to progressively correct the lower jaw's tendency to shift to the right.
- After the first 6 months, a full edgewise appliance,

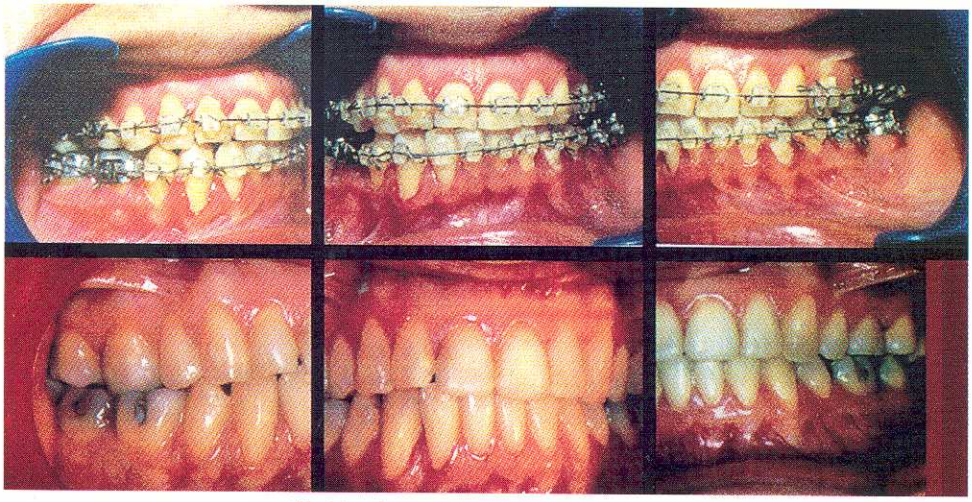


Fig 7. Posttreatment intraoral views.

Fig 8. Initial **(A)** and final **(B)** facial photographs.

with a modified transpalatal arch, was placed in order to align the teeth in the three planes.

- Composite was added to the upper right first molar and second premolar after 8 months. The palatal cusps were reshaped in order to prevent the lower jaw from sliding to the right during intercuspation.
- The lower canines cusps, especially the right one, were reshaped to prevent any shifting forward as well as to the right.
- The esthetic appearance of the upper incisors was adjusted after debonding.

Dentoalveolar and Jaw Relationships

The posttreatment cephalometric tracings (Figs 3 and 4) revealed the following:

- minimal alteration of the tooth and bone structure
- favorable profile changes with the correction of chin protrusion and jaw relationship while maintaining the angulation of the lower incisors
- in the frontal aspect, restoration of the horizontal symmetry of the mandible
- a readjustment of the vertical discrepancy between the left and right mandibular angles

Functional Analysis

The dental correction resulted in a more harmonious distribution of the occlusal forces on both sides, as recorded by the Periotest (Fig 5*A*). These results were confirmed 2 years after retention by means of the newly developed occlusal test with the Tek-Scan appliance (Tekscan, South Boston, Mass) (Table I). The cineocclusogram, or the movie of the occlusal contacts in maximum intercuspation, shows a good distribution between the different teeth with a slight preference for the right molars. The center of all occlusal forces is located within the range of the standard ellipse (Fig 5*B*).

The jaw tracking device (Fig 6*B*) settled this func-

tional analysis with the following assessments in 1995:

- a single maximum intercuspation posture with no sliding tendency as displayed by a good superposition of the initial and terminal points of all mandibular tracks
- no overriding of the lower jaw displacement along the midsagittal plane
- a good alternating chewing cycle with a well-defined mirror image

CONCLUSION

The treatment was completed in June 1995. Since then the patient has been seen twice a year to check her bonded retainer and to perform the Helkimo screening. The Biopart appliance is worn twice a week at night. She is symptomfree with no evidence of any TMJ trouble (Fig 6*A*). The use of a combined orthopedic-orthodontic treatment with crown reshaping to guide occlusion during the treatment avoided a complex surgical procedure. It is important for the clinician to be able to offer alternative choices to the patient that produces a good functioning environment for each individual.

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