The Eugnathically Adjusted Occlusal Splint: A New Concept

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Prosthetic reconstruction in adults within the framework of a functional diagnosis frequently requires preliminary treatment with an occlusal splint (Fig 1).[1–6] Proper design and function of this device are important for success of this initial therapy; it is easy to convert the intended positive effect of the splint into the opposite effect if it is not fabricated correctly. Unfortunately, the available literature is not particularly helpful regarding design requirements for the correct function of the splint.

The vacuum-forming fabrication process of the basic form of occlusal splints, which are finished with cold-curing material, has been found to be unstable.[4] Thermoplastic materials are not stable in form under pressure and, furthermore, absorb water from saliva. That leads quickly to strains in the splint and its instability on the master cast and in the mouth. When this occurs, the splint no longer can be worn.

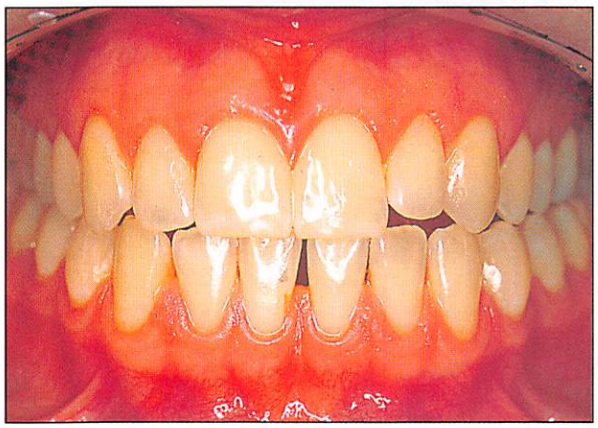

Fig 1 Initial appearance of patient who had undergone orthodontic treatment and had a vertical 1-mm overbite in habitual occlusion.

A new concept for fabrication of a eugnathic, adjustable splint has been developed to take these factors as well as economics into account. The concept was discussed with Drs R. Lee and A. Gutowski, two founders of functional diagnosis and modern gnathology.[4,6] Theoretical considerations then were converted to practice and have been tested successfully in more than 250 patients over a 3-year period. This article describes the design requirements and fabrication procedures for this new splint concept.

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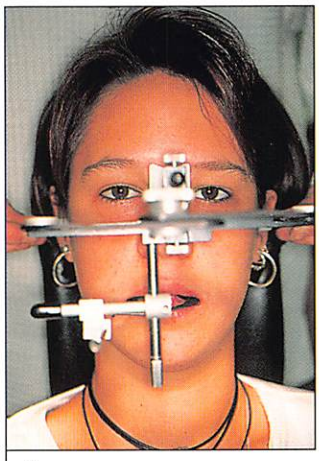

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Fig 2 Facebow serves to transfer the position of the maxilla to the articulator.

Fig 3 The adhesive technique provides a more secure fixation of the casts than does wax fixation.

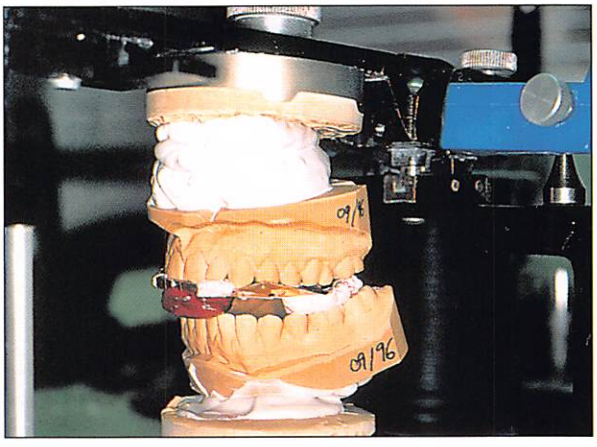

Fig 4 The centrically adjusted casts in the Panadent PCL articulator.

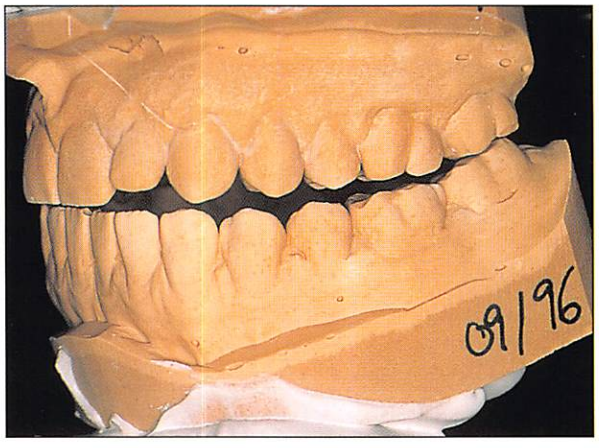

Fig 5 After removal of the bite registration, the variation in the position of the mandible from the initial habitual condition is obvious. The first centric contact is in the region of the second molars; the other teeth are discluded.

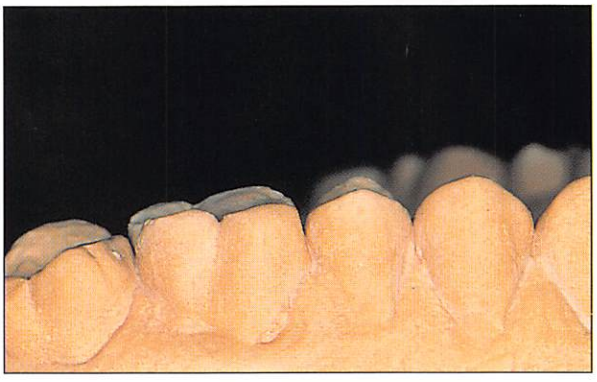

Fig 6 This strong interfering contact leads to strain and abrasion.

■ Requirements

Casts of the maxilla and mandible, an arbitrary facebow (Fig 2), a centric registration, and an adjustable articulator (Panadent)[1,2,4,6] serve as the basis for splint fabrication. An adhesive dispenser (Fig 3), articulator plaster, a plaster holder, and a spatula are also required. The casts are mounted in the articulator (Figs 4 to 6) and subjected to a split cast check. Articulator flaws, which arise frequently despite a careful working technique, can be found quickly in this way.

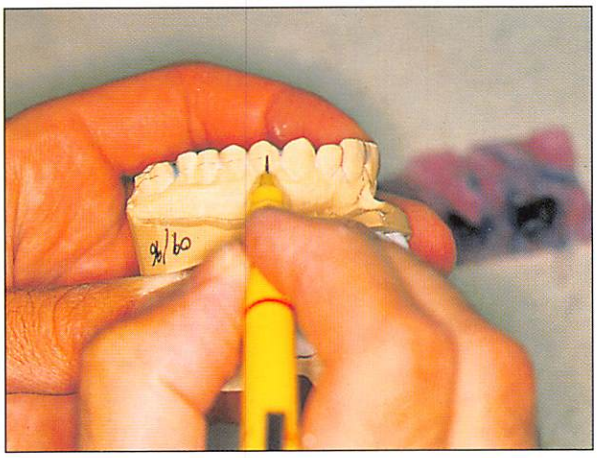

Fig 7 The margin of the splint ends at approximately the equator of the tooth.

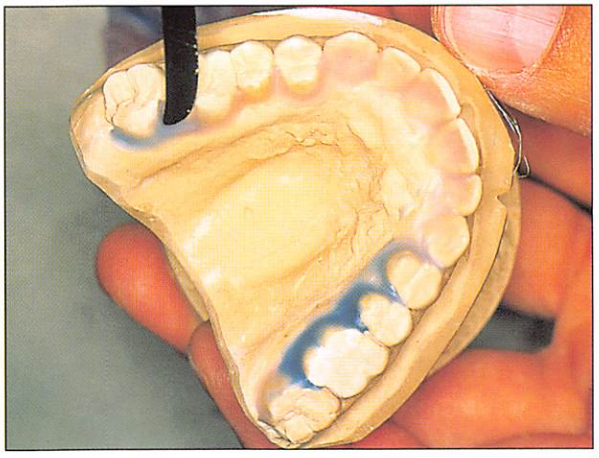

Fig 8 Undercuts are blocked out on the palatal surface.

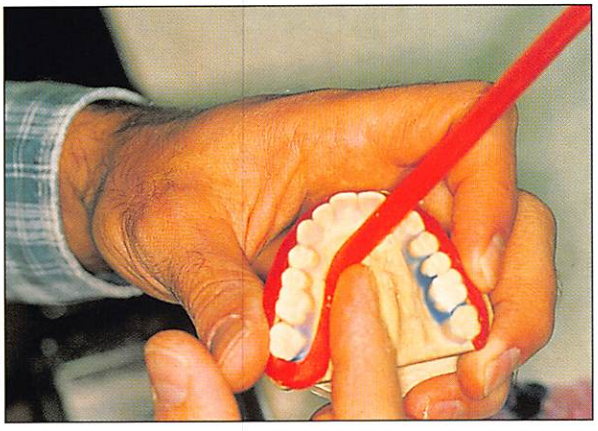

Fig 9 Functional margin protective wax is adapted to the markings.

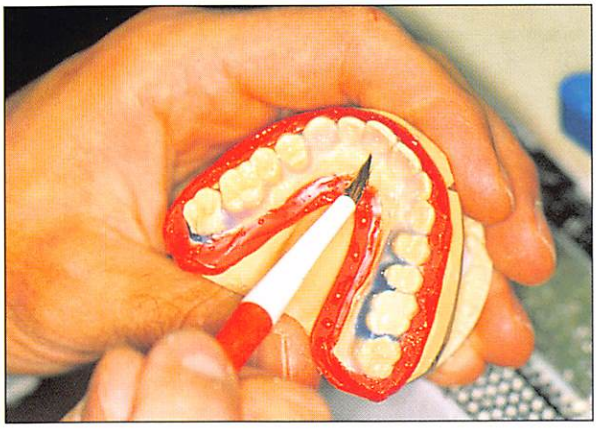

Fig 10 The prepared maxillary cast now can be coated with isolating agent.

■ Fabrication

As a first step, the margins of the splint in the maxilla are marked (Fig 7). This is followed by marking the entire expanse of the splint in the mandible. The following materials are required for these steps: casting wax wire (1.6 mm, 2.0 mm, and 3.0 mm) and functional margin protective wax (Bredent).

The functional margin protective wax is adapted according to the markings on the maxillary cast, demarcating the expanse of the splint (Figs 8 to 10). The wax is well suited for limiting the margins of the splint and is characterized by high adhesion and adaptability. (The more delicate the design of the splint, the greater the patient's acceptance and willingness to wear it.)

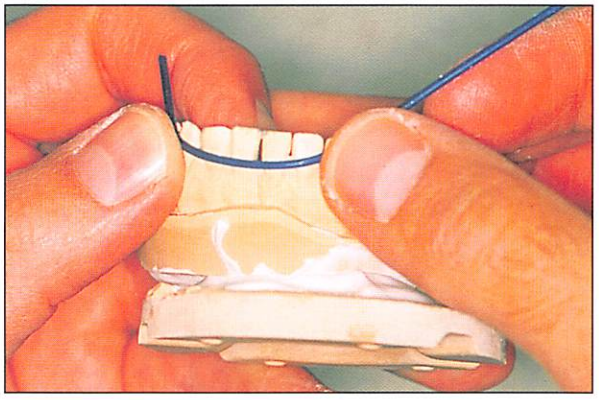

Fig 11 The 1.6-mm profile wax is applied to the marked margin.

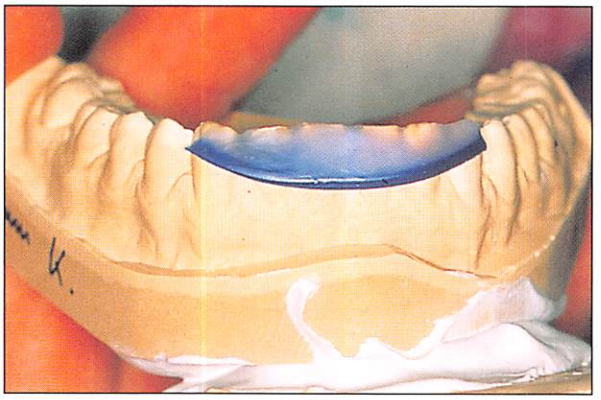

Fig 12 Interdental spaces at the incisal margin are filled.

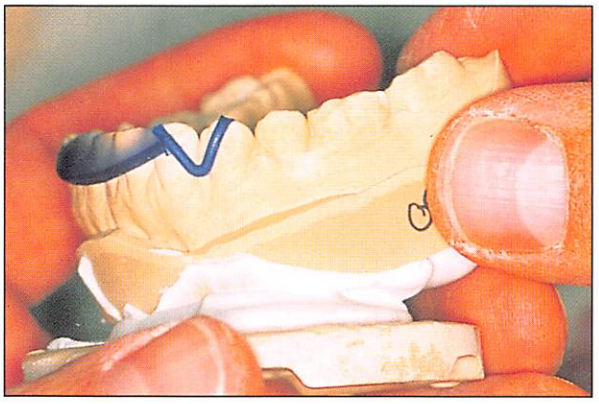

Fig 13 The position of the canine is defined between the mandibular canine and first premolar.

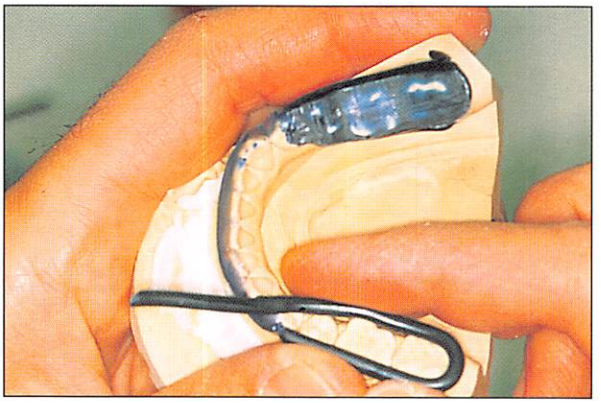

Fig 14 Posterior tooth reliefs are defined with 3-mm-diameter wax wire. Adaptation is along the cusp tips.

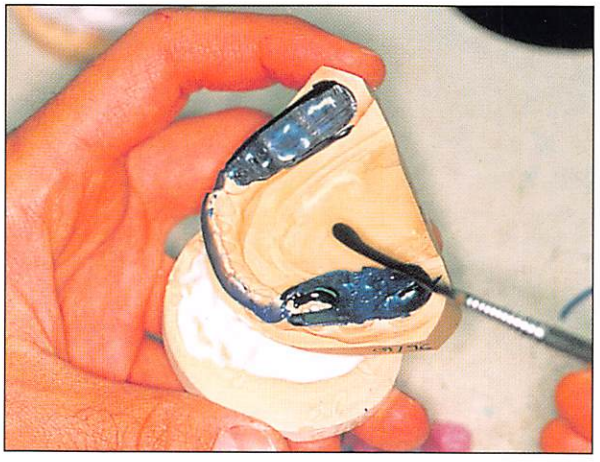

Fig 15 Interdental spaces are covered with wax.

Fig 16 The cusp tips are then exposed.

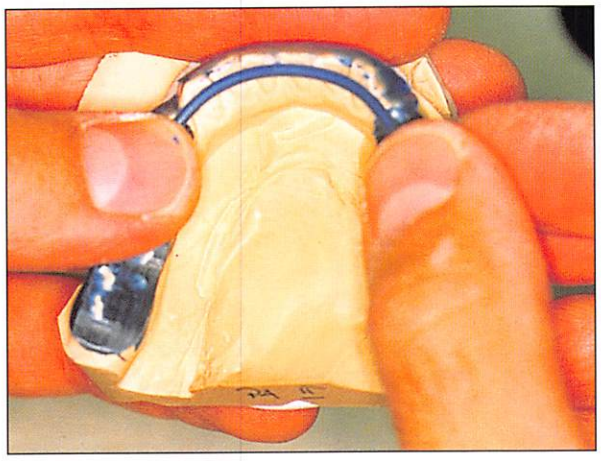

Fig 17 A 2-mm wax wire is placed lingually against the incisal edges of the teeth to prevent their fracture following polymerization.

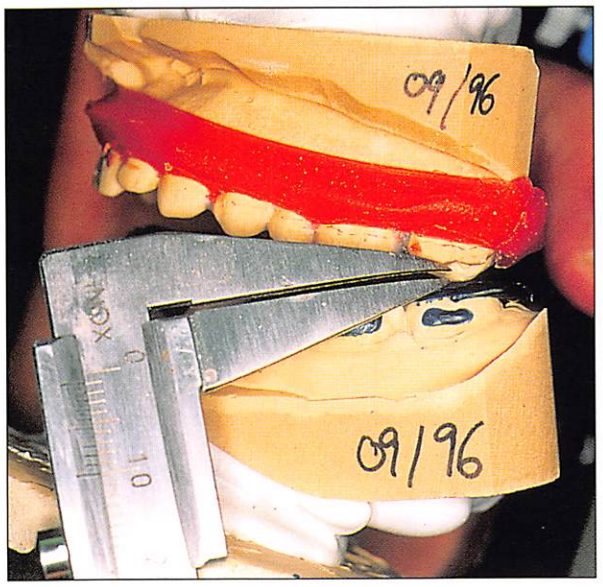

Fig 18 Bite elevation can vary, depending on the extent of the deviation between habitual and centric occlusion, but there should be approximately 1 mm of space above the first centric contact.

The following factors must be observed in the design of the mandibular wax pattern:

1. The ideal relation between the maxillary and the mandibular anterior teeth should be simulated with the occlusal splint.
2. Accordingly, the overbite should be 3 to 4 mm (vertical distance between the incisal edges of the central incisors) in each arch.
3. The overjet (distance between the incisal edges of the maxillary central incisors and the labial surface of the mandibular central incisors) should be approximately 1.2 mm in the horizontal dimension.
4. The tips of the canine guidance surfaces of the splint should be between the mandibular canine and the first premolar (neutral position).
5. The relief of the posterior teeth should be flat and provide only point-shaped contacts.

Anterior tooth guidance is adapted in a rising curve toward the canines with 1.6-mm profile wax (Figs 11 and 12). Then the position of the canines is fixed with the same wax (Fig 13). Posterior reliefs of the splint are formed with 3-mm profile wax. The wax is warmed and positioned at the level of the incisal edges. A sharp, warmed modeling instrument is used to coat the occlusal surface with the wax (Figs 14 to 16). Thereafter, only the cusps should be visible.

A 2-mm wax wire is placed from the lingual surface to the incisal edge of the anterior teeth (Fig 17) to avoid damage to the edge when the cold-cured splint is lifted from the cast. The support pin of the articulator must be carefully raised to provide space for the resin material (Fig 18).

■ Polymerization

Occlusal splints make several demands on the cold-curing material from which they are constructed:

- Complete polymerization in cold water, without formation of pores, in a short time
- No deformation under strain
- Sufficient hardness
- Good precision of fit
- Good modeling characteristics

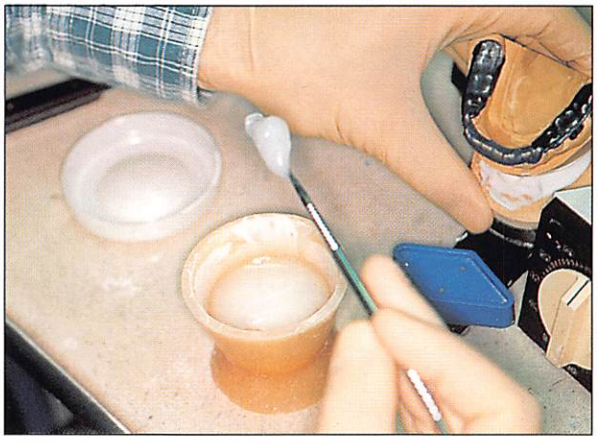

Fig 19 The wax pattern of the mandible is covered with the resin first.

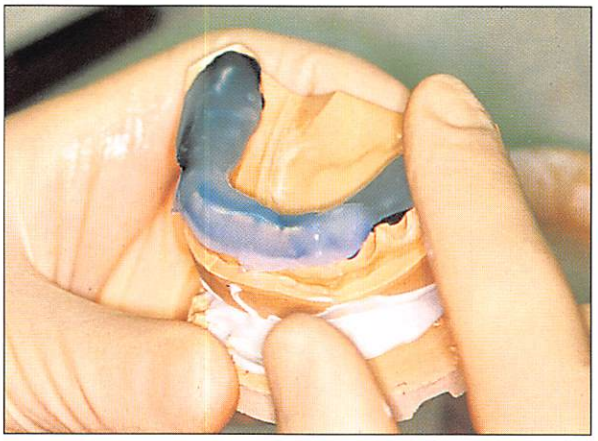

Fig 20 It is placed on the cast of the mandible and covered with the resin liquid.

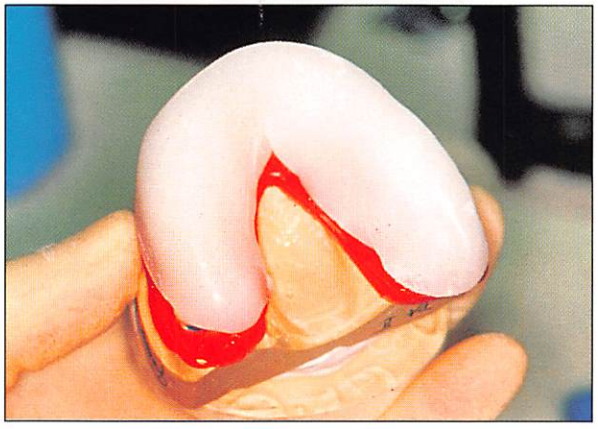

Fig 21 A shaped resin roll is placed over the cast of the maxilla.

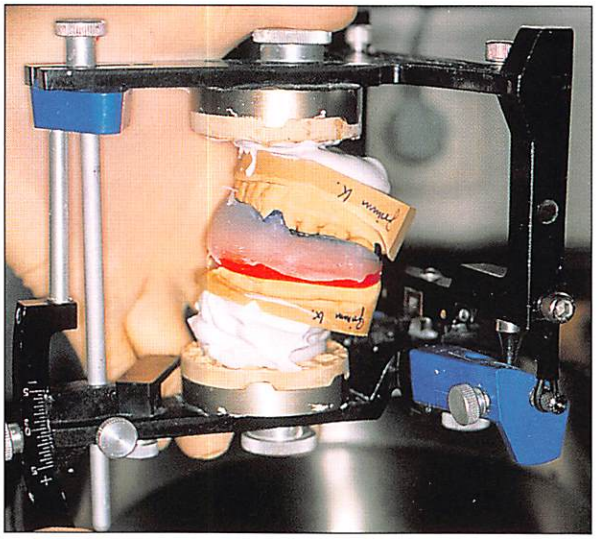

Fig 22 Polymerization follows, in the articulator. Cold water should be used to avoid formation of internal strains during polymerization. The curing process takes about 10 minutes.

These requirements are fulfilled by a product specially developed for this purpose: Resilit S (Erkodent, Pfalzgrafenweiler, Germany).

The casts are coated with an isolating agent. Depending on the room temperature, it may be necessary to cool the mixed curing material for a few minutes. A good modeling phase exists for about 3 minutes, during which time the material is spread on the casts (Figs 19 to 22). After excess is trimmed, the material is smoothed and allowed to polymerize for about 10 minutes in cold water.

■ Finishing

After polymerization is complete, the casts are taken out of the water bath and the splint is removed (Fig 23). The casts are cleaned and mounted in the articulator. Finishing of the splint begins with removal of excess material (Fig 24). Then the thickness of the splint is reduced to an even layer (Fig 25). The shape of the splint is fixed in the modeling stage and needs only to be refined. Then the splint is replaced on the cast of the maxilla and the precise adjustments are begun (Figs 26 and 27).

Fig 23 The splint can be removed from the cast after being taken out of the water bath.

Fig 24 Large excesses are trimmed first.

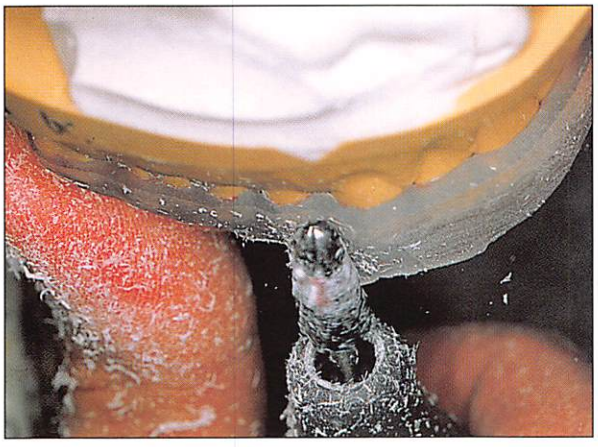

Fig 25 The splint is reduced to an even line on the cast.

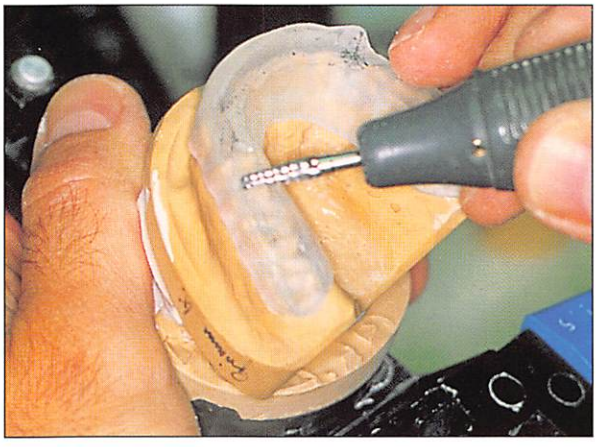

Fig 26 Centric contacts are marked with a black occlusal foil and ground in.

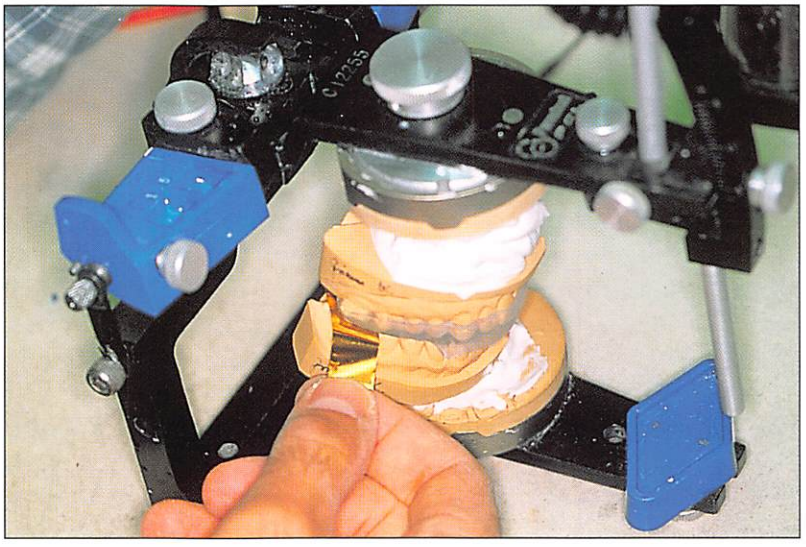

Fig 27 A shim stock foil is indispensable for precise adjustment of the contacts.

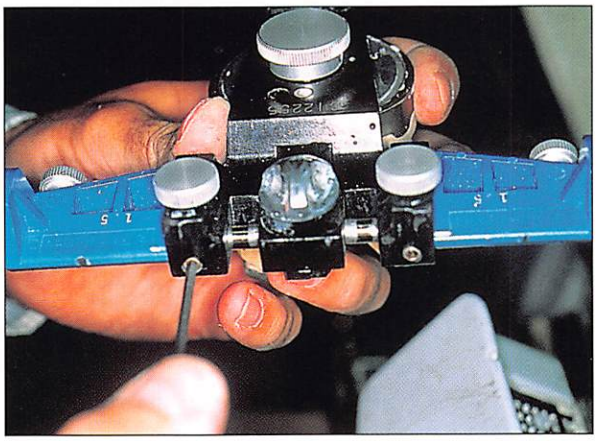

Fig 28 Joint boxes are removed for adjustment of protrusive movements.

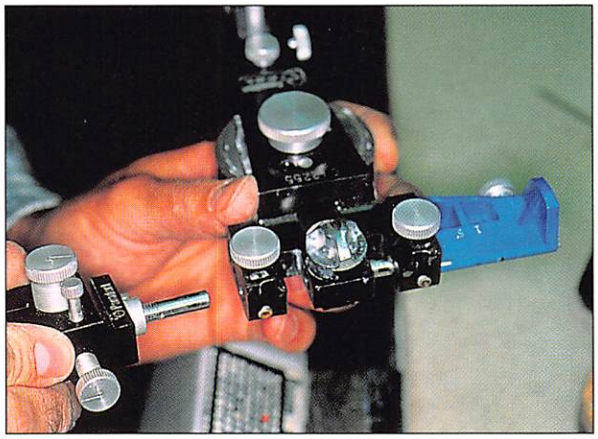

Fig 29 Joint boxes are replaced by the protrusive components.

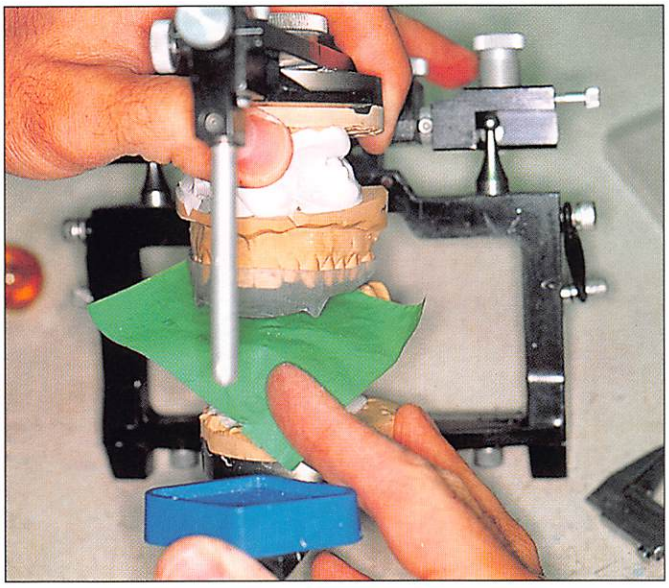

Fig 30 Contact strips are used for markings.

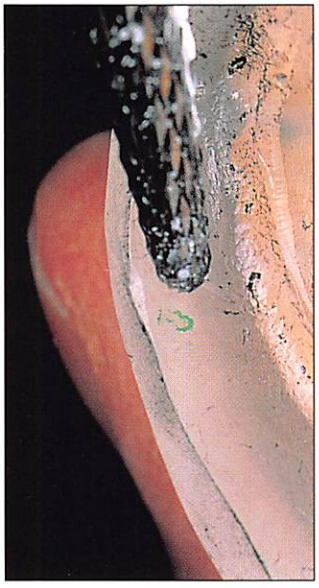

Fig 31 Adjustment of protrusion.

To adjust tooth contacts, a single occlusion marking foil is held in the posterior tooth region in the closed bite position, two foil thicknesses are held in the canine region, and four foil thicknesses are held in the anterior region.[4,6]

When this adjustment has been completed, protrusive movements are ground in. For this step, it is necessary to exchange the joint boxes of the articulator for the protrusion boxes (Figs 28 and 29). This makes a positional change possible in three dimensions, whereas only the protrusive pathways are ground in when the ordinary splint fabrication technique is used. The purpose here is to obtain even protrusive contacts on the mandibular incisors.

The first setting provides a protrusive adjustment of 3 mm, as the field of occlusion is approximately 3 mm^2. When balanced contacts are achieved on the anterior teeth, the protrusive adjustment is reduced by 1 mm

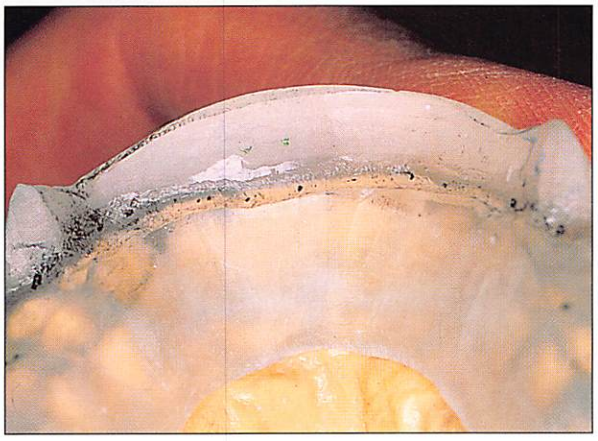

Fig 32 Balanced contacts of the mandibular central incisors are sought (green markings).

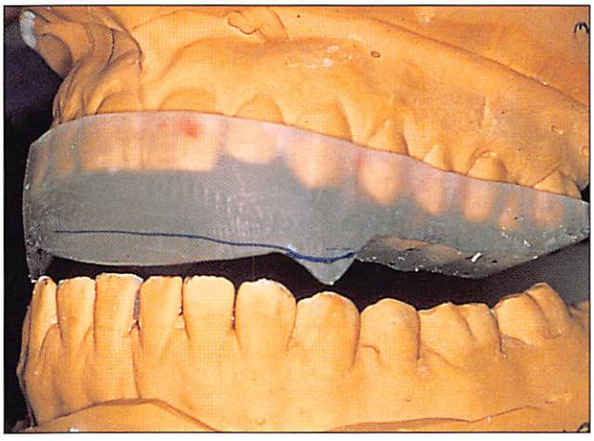

Fig 33 Canine guidance of the occlusal splint is checked.

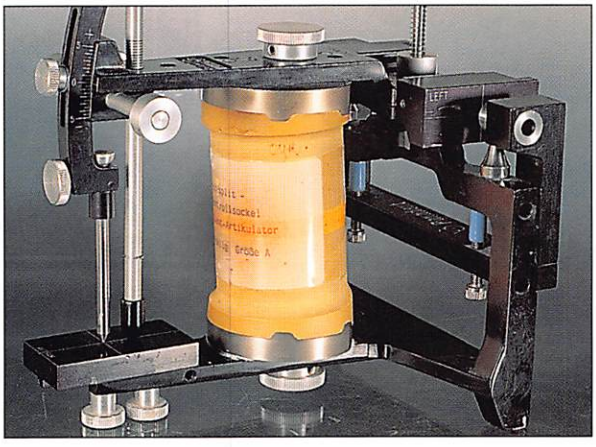

Fig 34 The condylar position indicator (CPI, Panadent) registers the position of the condyles.

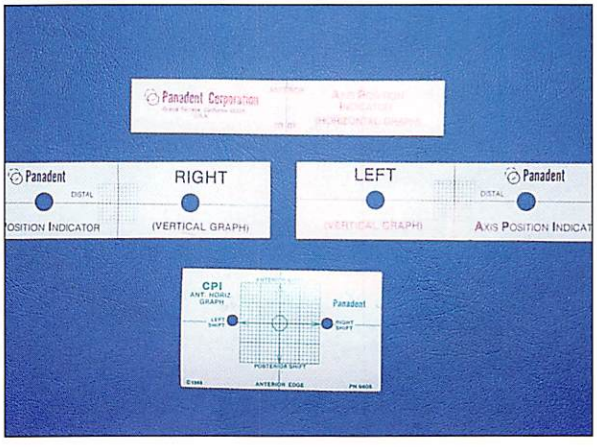

Fig 35 The marking strips are mounted on a special form after registration.

and ground in again. Then the protrusion is reduced by 1 mm again (Figs 30 and 31). The result is balanced contacts that, together with the eugnathic (neutral) position of the canines, provide ideal anterior tooth–canine guidance (Figs 32 and 33).

Finally, the splint is polished to a high shine on its labial and palatal surfaces, the functional components excepted. Polishing these components would destroy the carefully adjusted occlusal contacts.

Examining Condylar Position

A three-dimensional registration device has been developed to permit estimation of the position of the condyles and thus to describe a possible difference between habitual occlusion and centric relation[1,2] (Figs 34 to 38). The condylar position indicator (CPI, Panadent) marks these different positions. This examination is absolutely necessary if a definitive statement is to be made about a given patient.

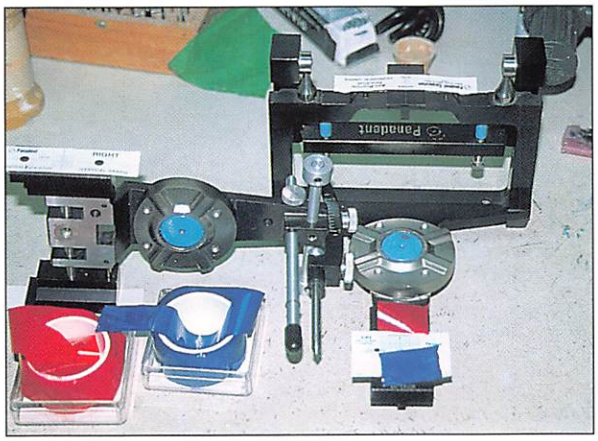

Fig 36 The prepared CPI.

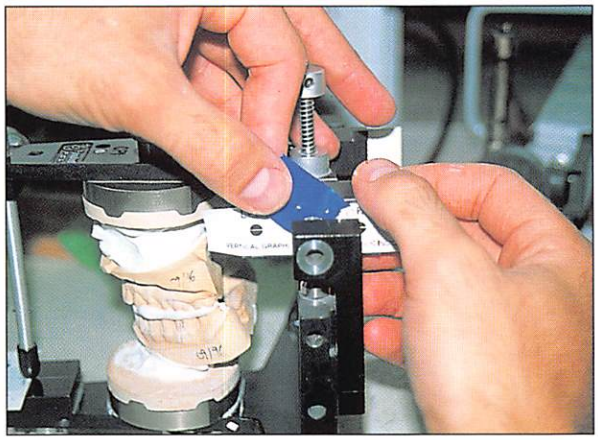

Fig 37 Blue foil marks the centric position.

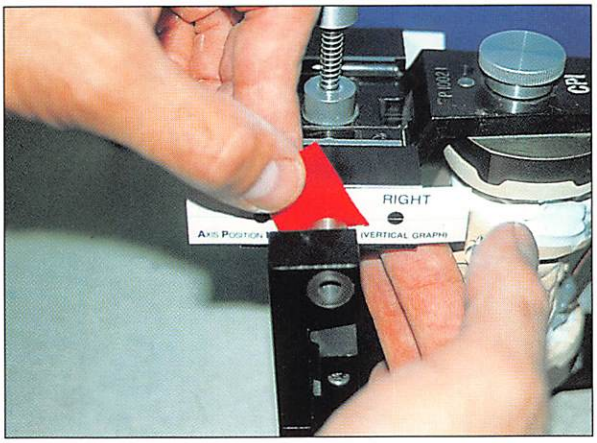

Fig 38 Red foil marks the habitual position.

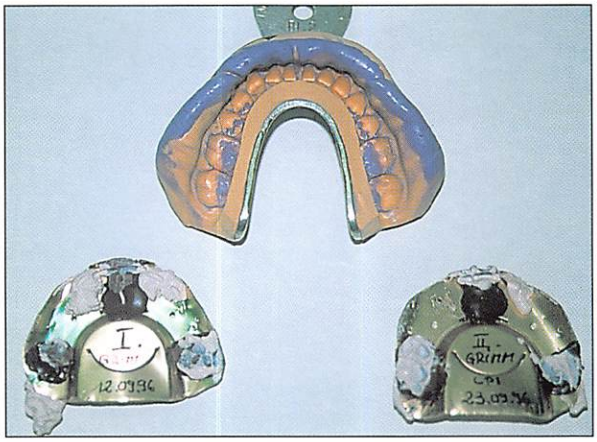

Fig 39 A new centric registration and a new impression of the mandible are prepared after the splint has been worn for about 3 weeks.

Fig 40 The registration is cut back with a scalpel to small impressions.

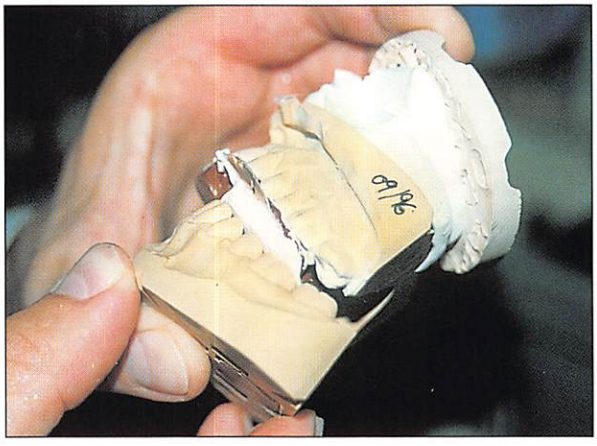

Fig 41 The cast of the maxilla, adjusted to an arbitrary position, and the new cast of the mandible are articulated with the new bite registration.

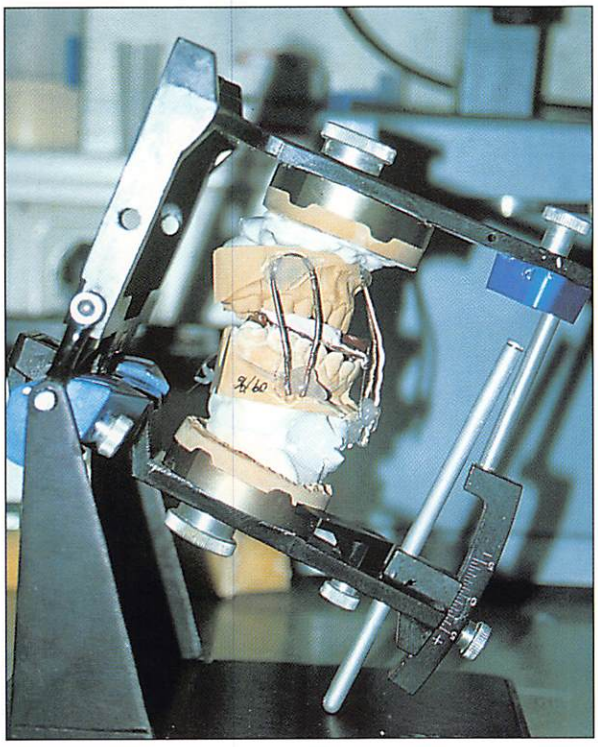

Fig 42 The plaster is allowed to harden.

Fig 43 The registration is removed after the plaster has hardened.

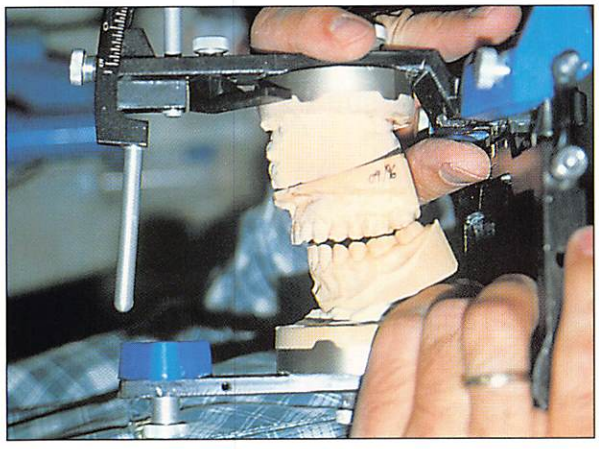

Fig 44 The casts are lowered to the initial tooth contact.

Fig 45 The position is keyed with articulator plaster.

Experience has shown that additional displacement of the condyles in the direction of a physiologic position of the temporomandibular joints occurs after the splint has been worn for several weeks (Figs 39 and 40). This can be demonstrated by a repeated registration. The new registration provides evidence of the effect of the splint on the participating structures and makes possible evaluation of the need for new adaptation (adjustment) of the splint to improve joint position (Figs 41 to 46). When three sequential registrations are identical, the patient's occlusion may be said to be stable and further restorative treatment can be planned (Fig 47).[1,7]

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Fig 46 The casts are mounted in the CPI and a new registration is made. If a change in the direction of the physiologic position (uppermost-foremost position) has occurred, the occlusal relief is adjusted accordingly.

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Fig 47 Splint inserted in the patient's mouth in maximum protrusion position. The posterior teeth are clearly separated.

■ Conclusion

In practice, this concept for the fabrication of a eugnathic, adjustable occlusal splint provides an efficient, cost-effective form of functional therapy.

An occlusal splint should:

1. Restore ideal anterior tooth–canine guidance oriented to Angle Class I
2. Provide defined, balanced occlusal contacts
3. Elicit no new traumatic occlusal contacts
4. Support muscular stabilization
5. Stabilize joint function

These requirements are fulfilled by the occlusal splint described here. Checking the position of the condyles offers a means for demonstrating the desired positive effect of the splint on the affected structures.

■ Acknowledgments

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