

The Occlusal Compass Concept: A Practical Approach to Posterior Tooth Morphology

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Dawson¹ suggests that teeth simply do not move out of alignment, do not get loose, and do not wear away without a specific underlying cause. Some authors have adopted different ideologies relating occlusion to posterior tooth morphology in attempts to correlate the two. This article is not meant to dispute any particular theory, but rather to remove the confusion that has developed.

The development and popularity of implants, managed care, and new materials and techniques have created new and different challenges for today's dental technician. The common use of osseointegrated implants, for example, has brought our focus back to occlusion and posterior tooth morphology. Branemark² stated that a poorly restored occlusion on osseointegrated implants could have deleterious effects on the prosthesis and supporting bone. Meeting these challenges requires greater efficiencies in practice and business.

One way to meet these challenges when fabricating single or multiple restorations is to take time to examine the preoperative casts before waxing the case, looking for problems that may exist on the dentition. Preoperative casts are like road maps. They show you where the patient has been, and you select which route is best for that particular case. It is well accepted that occlusal patterns should be developed to satisfy the patient's needs rather than to fulfill a stereotyped concept. This truly requires a team effort.

Most agree that one of the purposes of posterior tooth morphology is to aid the patient in the mastication of food while maintaining freedom of contact in all border movements, as described by Posselt³. Posselt's envelope of motion has been separated into three planes of space: sagittal, frontal, and horizontal. The early work of Lundeen and Gibbs⁴ suggests that we also have to take into account the characteristic pattern of chewing cycles. Current articles by Lauret and LeGall⁵ discuss the use of electrognathography, which enables the recording of the characteristic pattern of chewing cycles as well as the neurophysiologic and kinetic data of the actual function of mastication.

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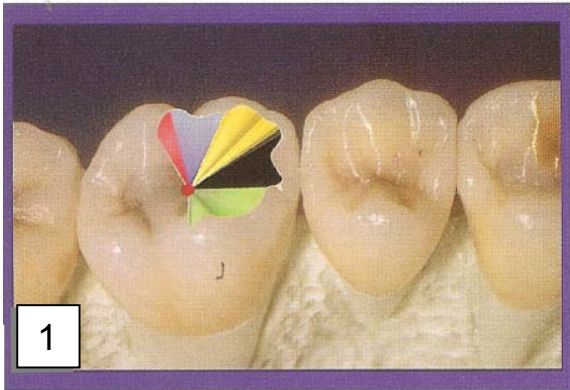


Fig 1 The occlusal compass radiating out from the fossa of a maxillary first molar: protrusion (*black*), laterotrusion (*blue*), lateroprotrusion (*yellow*), lateroresurtrusion (*red*), mediotrusion (*green*).

The dynamic interrelationship of teeth is not limited to movement in just one plane. As described by Douglass and De Vreugd,⁶ a three-dimensional pattern, which is actually a summation of a cusp's movement in all three planes of motion, is called that cusp's "occlusal compass" (Fig 1). Every occlusal compass has elevations and depressions, and for any given cusp it will vary somewhat from that of any other cusp as a function of its bearing to the mandibular rotation centers. This suggests that there is not one type of occlusal morphology suitable for every patient.

Instrumentation has yet to be developed that exactly replicates that patient's chewing cycle. We must first look at natural tooth morphology and the inherent limitations of our current articulators, and then build in the additional freedom within the occlusal compass for the opposing cusp movement. Polz⁷ developed a "biomechanical" wax-up technique around this theory.

This article will attempt to bring common sense and time-proven experience to develop an ideal functional occlusal morphology on a maxillary first molar as part of a maxillary reconstruction. A mandibular first molar will also be described. These two teeth have been chosen because during mastication, the first and second molars bear the most force and the highest number of contacts.

The type of occlusal design used is based on the dentist's diagnostic skills as well as the information communicated to the dental technician.⁸ The dentist/technician team must rely on records for the articulation of the teeth, consideration of future restorations, and bone support to decide the best course of treatment for each patient. With these considerations, the need for time-consuming chairside adjustments and costly remakes can be reduced or eliminated.

The occlusal terminology used in this article to describe the occlusal compass has been taken from the glossary of occlusal terms formulated by the Glossary Committee of the International Academy of Gnathology. It is important to remember that mandibular movements not only leave from centric, they return to centric during the chewing strokes and when we swallow. These movements are *protrusion*, the forward thrust of the mandible; *laterotrusion*, side thrust laterally or outward; *lateroprotrusion*, outward and forward thrust; *lateroresurtrusion*, outward, backward, and upward thrust; and *mediotrusion*, side thrust medially or inward, downward and forward thrust of the nonworking condyle (see Fig 1).

Example 1: Maxillary Molar

We start by examining the existing morphology of the maxillary left first molar (Fig 2), hardly an aid in the mastication of food. All restorative materials, such as amalgam (Fig 3), pressed ceramic, etc, should be manipulated using the occlusal compass. This can be seen in the finished wax-up (Fig 4a).

As we add wax on the occlusal surface, it is important to remember to move the mandibular cast to the outside border movement and glide back to the centric stop; i.e., move the mandibular cast to an edge-to-edge position with the central incisors for protrusive, then glide back to the centric stop (Fig 4b). Repeat this with all compass movements until the wax-up is complete.

Fig 2 Maxillary first molar previously restored with amalgam. Note the lack of occlusal morphology and interproximal access for the patient to floss.

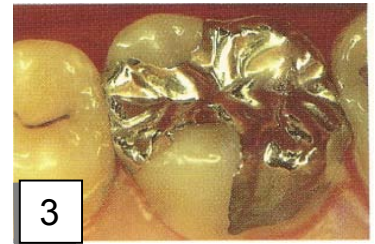
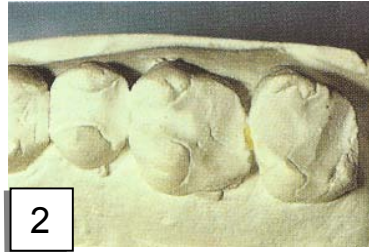


Fig 3 Proper occlusal morphology on an amalgam restoration. (Photo courtesy of Dr Rudiger Butz, Moers, Germany).

Fig 4a Ideal occlusal morphology and contour using the occlusal compass concept.

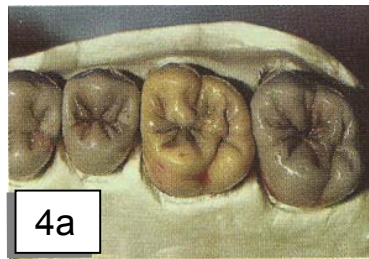
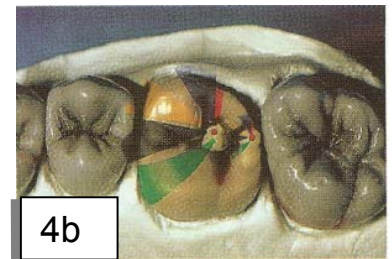
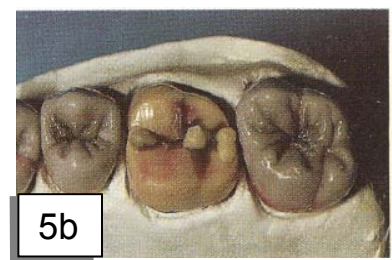
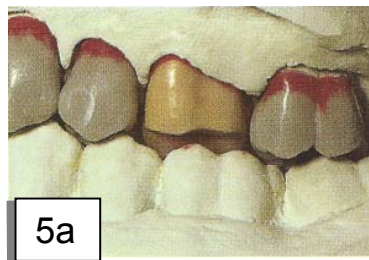


Fig 4b Occlusal compass direction back to ICP on both centric stops.



Figs 5a and 5b Models together in total intercuspation. It is easy to identify the number of centric stops. In this case, there will be two: the first lines up above the mesial buccal cusp of the mandibular molar, the second on the distal marginal ridge above the mandibular middle buccal cusp.



After the wax pattern is adapted to the die, transfer to the working cast and examine the models in total intercuspation. Note where the mandibular opposing cusps line up in the maxillary fossa (Figs 5a and 5b). There are two mandibular cusps to work with in this example, one near the central fossa and the other on the distal marginal ridge. Our goal is to obtain the maximum number of axially directed contacts that are equal in intensity and centered over the roots.

Using an electric waxer (Fig 6), build up wax cones that will serve as centric stops for the opposing cusps (Fig 7). Next add the lingual and buccal cusp cones (Fig 8). The mesial lingual cusp should line up in the mandibular molar fossa. The buccal cusps should be free of contact throughout the compass movements. Add the mesial and distal contacts and complete the axial contours (Fig 9).

Begin the occlusal morphology by waxing the mesial buccal triangular and marginal ridges (Figs 10a and 10b). Check the morphology first in protrusion: with the anteriors placed edge to edge, guide the mandible back to the centric stop in the intercuspal position (ICP). Position the canines edge to edge in laterotrusion and return to ICP.

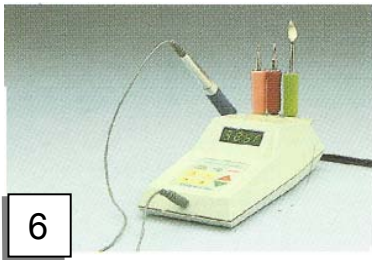


Fig 6 Ultra-Waxer (Belle de St Claire, Chatsworth, CA)

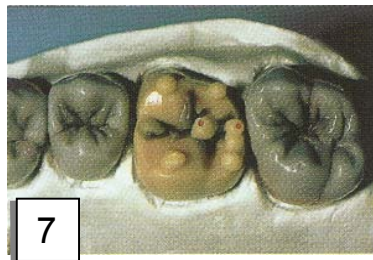


Fig 7 Centric stops are built up until contact with opposing cusps (red dots).

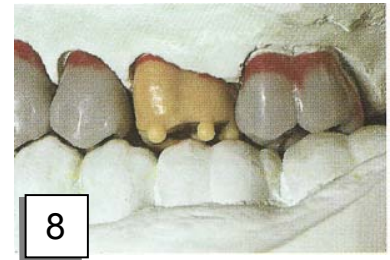
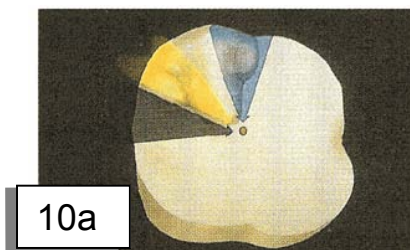


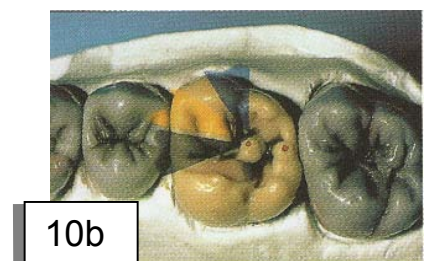
Fig 8 Addition of the lingual and buccal cusp cones. The mandibular cast is moved through all compass movements to be sure that the cusps travel freely.



Fig 9 Cusp cones are joined, mesial and distal contacts are added, and contour is finished.



10a



10b

Fig 10a and 10 b Black arrow indicates the mandibular movement back to ICP (red dot) from the most protrusive position. Blue arrow indicates the movement back to ICP from laterotrusion (canine to canine). Yellow arrow indicates lateroprotrusion (central, lateral, and canine together, then back to ICP).

Position the centrals, laterals, and canines edge to edge (lateroprotrusion), and return to ICP. This is a very important movement in the chewing stroke. There should be total freedom of contact in all of these compass movements.

Next add the distal buccal triangular and marginal ridges (Fig 11). Repeat the compass movements as described above. In addition, free up lateroresurtrusion for the Bennett movement (Fig 12).

Wax in the mesial lingual triangular and marginal ridges. Mediotrusion is a nonworking side movement (Fig 13).

Finish the wax-up with the distal lingual triangular and marginal ridges (Fig 14). This addition should not interfere with the mediotrusion movement from the centric stop on the distal marginal ridge.

The completed maxillary molar wax-up and final restoration with the compass movements are shown in Figs 15a and 15b. Use this same concept to complete all of the maxillary restorations in wax (Fig 16). The finished case is shown in Fig 17.



Fig 11 Addition of distal buccal triangular and marginal ridge.

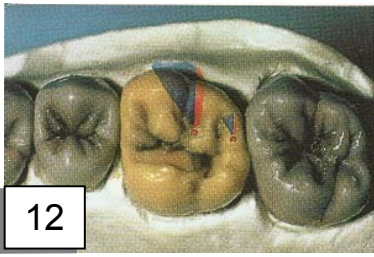


Fig 12 Note laterotrusion (*blue arrow*) movement to both centric stops (*red dots*). In addition, lateroresurtrusion (*red arrow*) is evaluated for side shift.

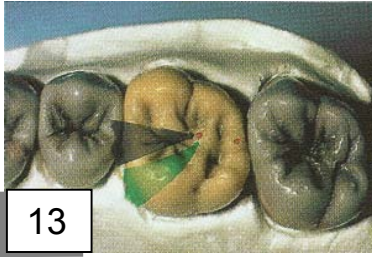


Fig 13 Mediotrusion (*green arrow*), a side thrust medially, is a nonworking movement.

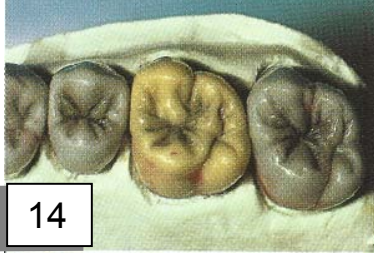


Fig 14 Completed wax-up after the addition of the distal lingual marginal and triangular ridge.

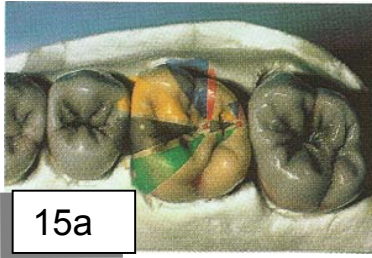


Fig 15a Finished wax-up with occlusal compass overlay.

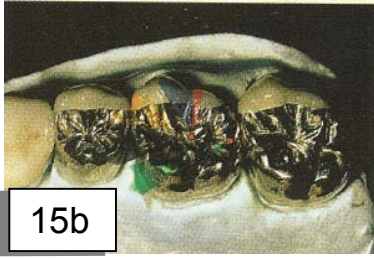
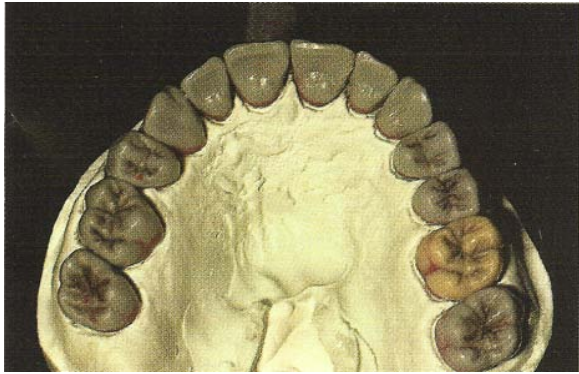
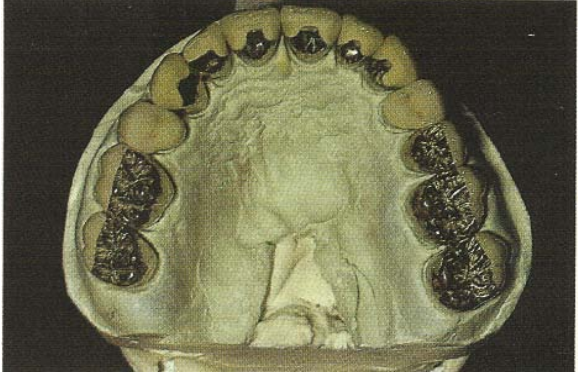


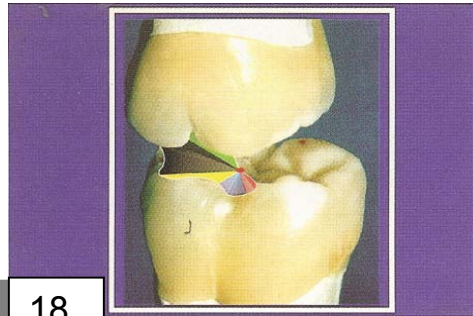
Fig 15b Final restoration with occlusal compass overlay.



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Fig 16 Maxillary arch completed in wax.

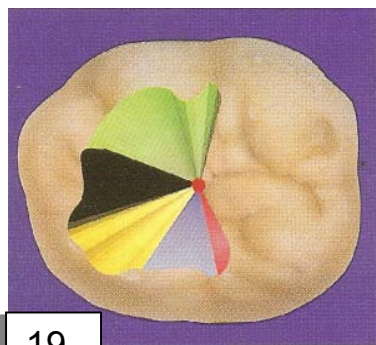
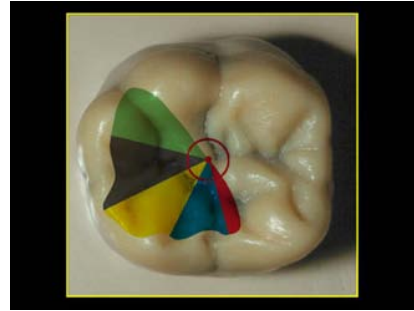


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Fig 17 Finished metal ceramic restorations.



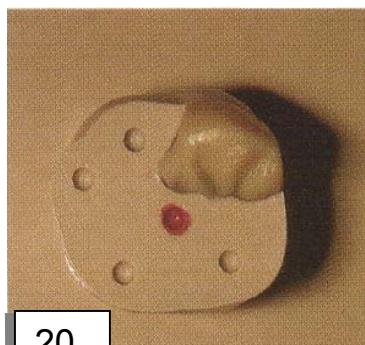
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Fig 18 Maxillary lingual cusp in fossa of mandibular molar with compass movements.



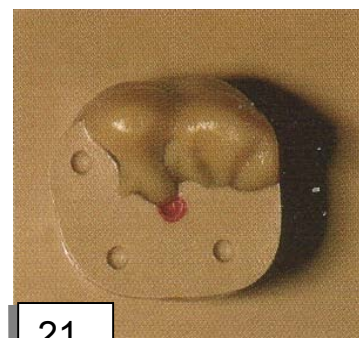
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Fig 19 Occlusal compass for mandibular molar.



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Fig 20 Placement of mesial buccal cusp, triangular and marginal ridges.



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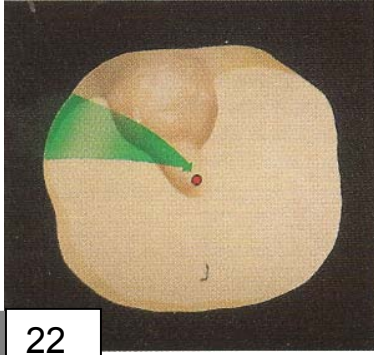
Fig 21 Addition of middle buccal cusp and triangular ridge.

Example 2: Mandibular Molar

The mandibular first molar is waxed using the same principles described in example 1. As wax is added, check each compass movement starting at the outside border movement, then glide the instruments or models back to ICP.

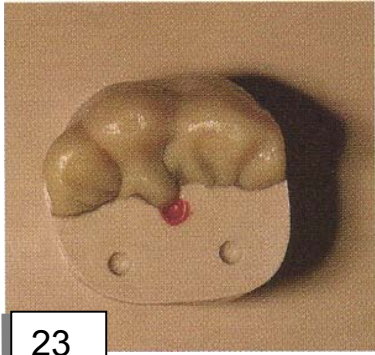
The morphology will change to meet the requirements of each patient. I will demonstrate how the occlusal compass was used with the maxillary lingual cusp positioned in the central fossa of the mandibular left first molar (Fig 18). The concept holds true for maxillary contacts on the occlusal surface of our mandibular teeth (Fig 19).

Start the wax-up with the mesial buccal cusp and triangular ridge (Fig 20), followed by the middle buccal cusp and triangular ridge (Fig 21). The height of the triangular ridge is determined by the mediotrusion movement (Fig 22). Next add the distal buccal cusp (Fig 23). Check in protrusion and mediotrusion (Fig 24). The mesial lingual cusp and triangular ridge are waxed to accommodate the centric stop (Fig 25); their form is dictated by laterotrusion and lateroresurtrusion (Fig 26). Finally, the distal lingual cusp and triangular ridge are waxed (Fig 27). This step must have total freedom in laterotrusion, lateroprotrusion, and protrusion (Fig 28). The finished morphology has been developed by the occlusal compass, which was determined by the anterior coupling, angle of the eminentia, and muscles and ligaments.



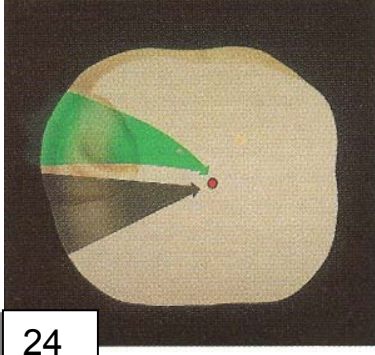
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Fig 22 Mediotrusion (green arrow) pathway to ICP.



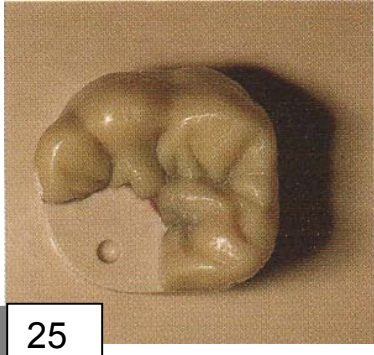
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Fig 23 Distal buccal cusp and triangular and marginal ridges added.



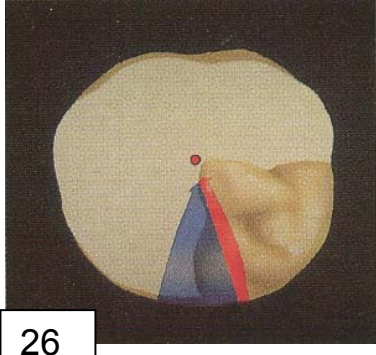
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Fig 24 Mediotrusion (green arrow) and protrusive (black arrow) path to ICP.



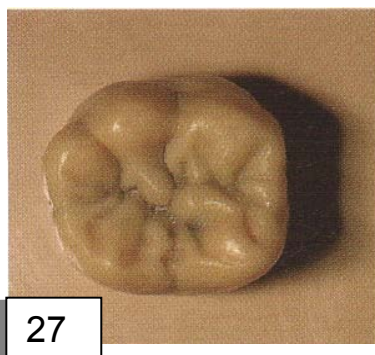
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Fig 25 Mesial lingual cusp and triangular and marginal ridges added.



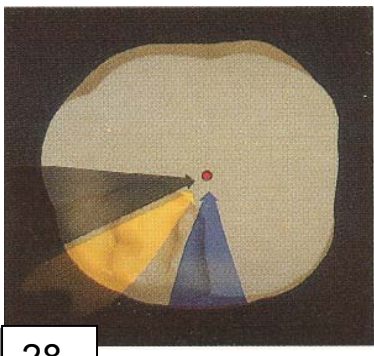
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Fig 26 Laterotrusion (blue arrow) and lateroresurtrusion (red arrow) back to ICP.



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Fig 27 Addition of distal lingual cusp and triangular and marginal ridges to complete the wax-up.



28

Fig. 28 Laterotrusion (blue arrow), lateroprotrusion (yellow arrow), and protrusion (black arrow) are critical in this final step.

Acknowledgments

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