Is complete denture stability during chewing possible?

PART I of II

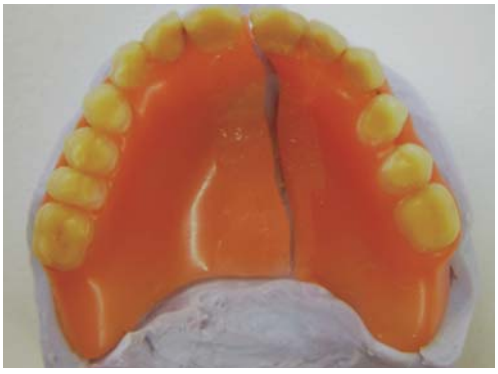
By Max Bosshart, Master Dental Technician, Prosthetist
Matthias Bickel, Dr. med. dent., PhD, Prosthodontist

"To obtain unilateral chewing stability: forget about balanced occlusion, it doesn't work, but balanced occlusion is essential during parafunctional mandibular movements to prevent unbalanced loads on the supporting alveolar ridges."

This blunt statement shall guide us through some critical steps when making complete dentures, overdentures and free-end saddle removable partial dentures. The present article shows how one can achieve optimal chewing comfort for edentulous patients. It takes us back more than half a decade when some renowned prosthodontists made significant observations that led to a new concept, namely a modified lingualised occlusion. Furthermore, it reveals some of the reasons why dentures may fracture when this concept is not used.

The five pivotal points define what is considered essential:

1. Food is almost always chewed on one side only (Hiltebrandt, 1933/35).[1]
2. During mastication, the teeth of the denture wearer only finally come into contact when the food load has become softened (A. Gerber, 1946).[2,3]
3. Therefore bi-lateral equilibration is ineffective for chewing stability.
4. For unilateral chewing stability of dentures, immobility is the key.
5. Parafunctional contacts occur during the day and night. In order to distribute resulting forces evenly, correct centric and equilibrating contacts are necessary.



The result of a denture that is incorrectly loaded.

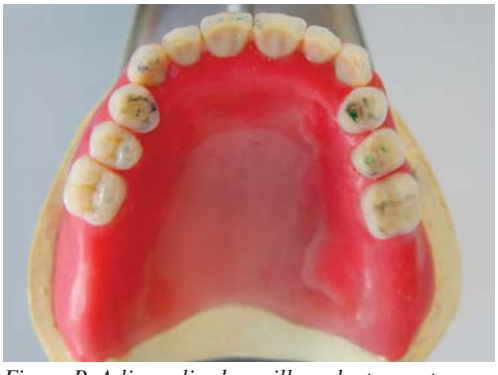


Figure B. A lingualised maxillary denture set-up that allows full denture stability during chewing.

The study from Suguru Kimoto et al[4] showed greater satisfaction of the patient wearing dentures with a lingualised occlusion concept. Another

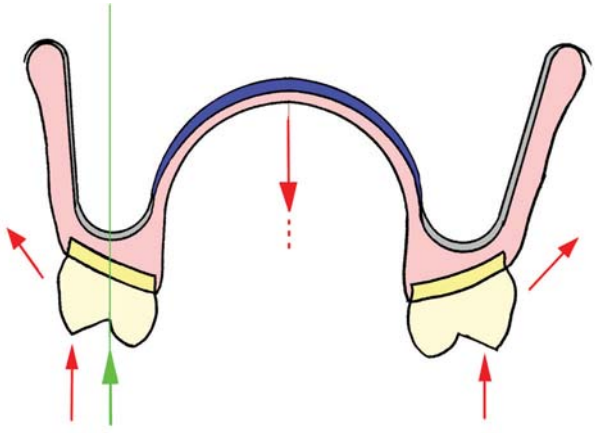


Figure 1. The ideal point of pressure on the tooth is the area shown with a green arrow. The chewing force is directed to the middle of the alveolar ridge. Forces directed in a more buccal direction, as the red arrows show, progressively increase the deformation of the denture. The denture is no longer well fitting (blue area) and in time, could initiate a crack zone in the palatal part of the denture.

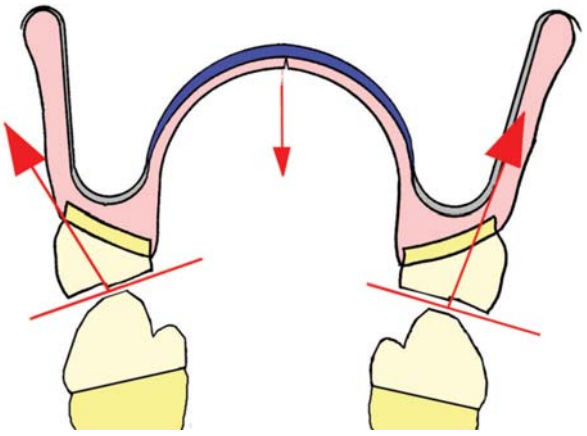


Figure 2. The mandibular teeth exert pressure on the maxillary teeth in a buccal direction (red arrow). This multiple cyclic reaction can lead to a crack in the denture and a gap developing between the denture and the torus palatinus.

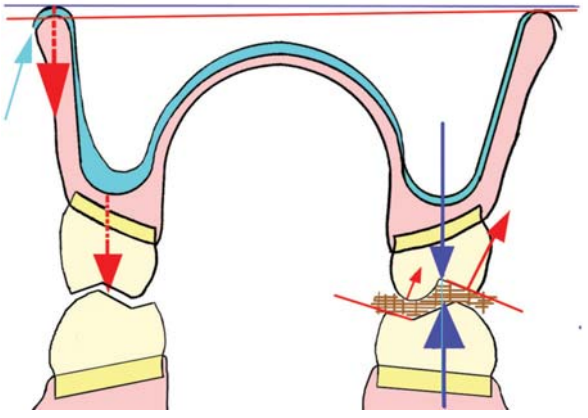


Figure 3. Buccal cusp contact during mastication is a handicap. Too much force is placed buccal of the ridge during working mastication, resulting in a tilting maxillary denture and furthermore an un-supported direction of masticatory force.

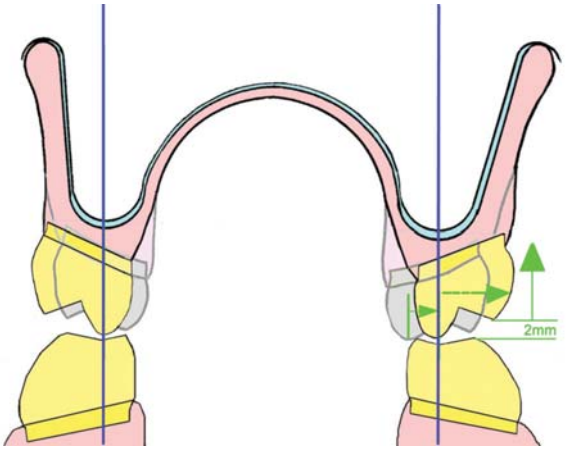


Figure 4. With the reduction of the buccal cusps (min. 2mm), we have the mastication force in the lingual/palatal area, which is orientated almost vertically.

article "The effect of occlusal contact localisation on the stress distribution in complete maxillary denture",[5] describes the link between stress distribution and broken dentures. According to this study, it is the type of occlusion and the positioning of the teeth in relation to the alveolar ridge, which lead to denture destabilising forces and broken dentures.

1. Functional reasons why dentures break

Incorrect positioning of posterior teeth

From a mechanical point of view, the ideal point of pressure on the tooth is the area shown in Figure 1 indicated with a green arrow. The chewing force is directed onto the middle of the alveolar ridge. Forces directed in a more buccal direction progressively increase the deformation of the denture. The denture is no longer well-fitting (blue area) and, in time, a crack zone may be initiated in the palatal part of the denture.

Abrasion and centric anterior tooth contact

Also of importance is the mould of the teeth. By losing the main palatal cusps on the maxillary denture, we get more pressure on the buccal cusps. The buccal cusps are further from the midline resulting in greater leverage and concentration of occlusal forces in the palatal area of the denture. This increases the likelihood of crack formation in the palatal part of the denture (Figure 2). Because of the inclination of the occlusal surface, shown in Figure 2, the resulting orientation of the forces, upwards and outwards, increases the deformation of the denture base, which in turn may also lead to crack formation in the denture base and even damage of the alveolar bone.

Usually, we can easily distinguish between a functional breakage and an accidental breakage of a denture by the signs of fatigue associated with functional breakage. Of course, we could also ask the patient what happened. If such a reoccurrence is to be prevented, then it is essential to appreciate the functional origin of palatal fractures.

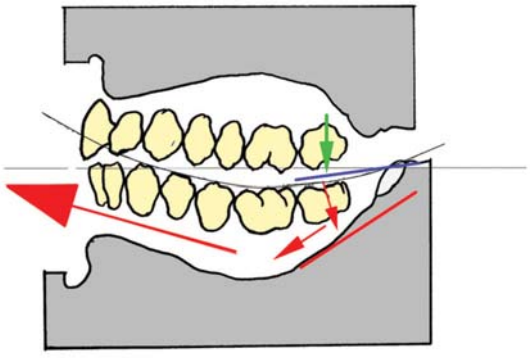


Figure 5. In a "textbook" conventional set-up, the last molar is positioned correctly; the occlusal level and curve of Spee have been observed. However, the masticatory force is not at 90° to the ridge and the denture moves down the sloping ridge and moves forward and upward.

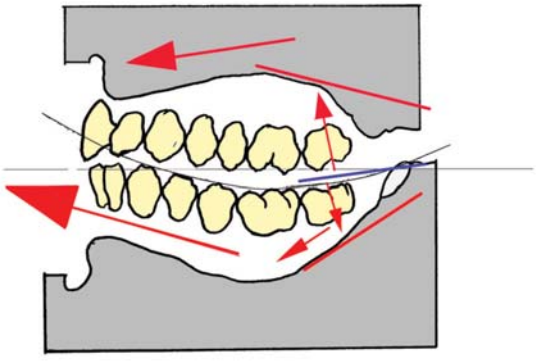


Figure 6 shows in which direction the masticatory force on the maxilla is directed. As a consequence of the poor position of the teeth, according to the curve of Spee, the force is in a disadvantageous angle to the ridge and the pressure pushes the maxillary denture forward.

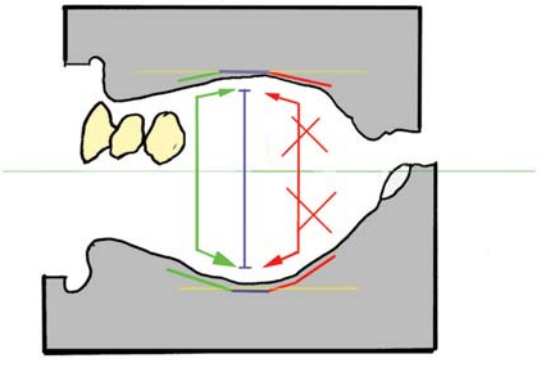


Figure 7. The positive zones, shown in green, are mostly in the pre-molar area. The axis of the pre-molars pushes the denture backwards to the respective ridge during mastication, giving a 'super' stable situation. The deepest area in the mandible and the highest part of the maxilla are the neutral zones, shown in blue. In this area, we set the first molars (largest teeth). We can recognise again as on Figures 5 and 6 that the retro-molar area is critical, shown in red. The directions of the maxillary and mandibular ridge in the posterior part are not parallel to each other. We cannot set any teeth in this area that will be stable during mastication.

As posterior contacts wear over time, anterior and canine guidance are created. Although this may be judged to be satisfactory in a natural dentition, in complete dentures this can provoke a tilting action and a subsequent dropping of the denture in the post dam region leading to an unsatisfactory denture for the patient. This tilting action is thought to be one factor involved in maxillary anterior fibrous ridge replacement and fracturing of the maxillary denture.

Conclusion

Broken dentures are a good indication of instability caused by instable positions or wrong contacts of the artificial teeth. It is in these cases that pathological damage can be caused. We can use high-impact acrylic or just repair the denture, but in both cases, the pathological damage may continue. The results are flabby ridges and increased bone resorption. Masticatory efficiency is very restricted and the patient could experience pain. To avoid these problems we need defined tooth contacts and periodic reviews.

2. Tooth position and denture stability

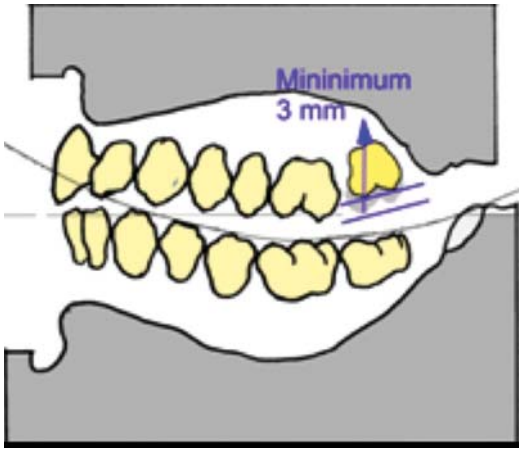
Many years ago, different authors discovered the problem of the unstable denture (Hiltebrandt 1933,[1] Payne 1941,[6] Gerber 1946[2]). All of them proposed a specific lingualised occlusal concept to solve the problem. In Europe in 1958, Albert Gerber from Zurich developed the so-called "Gerber-Method". It is still recognised as one of the best systems available today.[7,8]

Conventional tooth set-up

In the conventional set-up, the mandibular buccal cusps are on the crest of the ridge (or more lingual); in the maxilla, the central groove is straight over the crest of the ridge (Gysi 1914/17).[9] Buccal cusp contact in a conventional set-up during mastication is a handicap. Too much force is exerted buccal of the ridge, resulting in an unstable denture (Figure 3). In a lingualised occlusion, the buccal cusps are reduced (min. 2mm) so the masticatory forces are directed over the lingual-palatal area and the centre of the ridge. In this way, the denture is more stable during mastication (Figure 4). A correlation of denture instability and progressive alveolar bone resorption[4] exists and this correlation may be population specific. A personal observation, made by the author of Japanese edentulous patients, revealed a significantly better situation in comparison with a Caucasian population. Their alveolar ridges appeared distinctly wider and showed significantly less resorption over time. These characteristics clearly favour denture stability. It may explain the reason why Kimoto et al found little or no difference in the mastication performance of edentulous patients when comparing lingualised and conventional occlusal schemes. Long-term results could show different results when the fit of the dentures deteriorate.

The Gerber System set-up

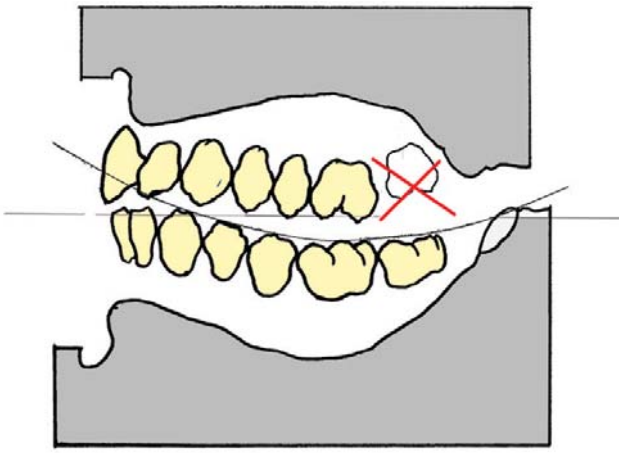
In this system, we position the upper teeth almost vertically on the crest of the ridge (Figure 4). This aids denture stability with the advantage that the teeth can be placed more buccally. This not only provides better cheek contact and more tongue space but also helps prevent it from slipping under the denture.



Figures 8a and 8b. In this set-up, the second maxillary molar is 3mm out of contact. Therefore it is not possible to chew on it. Also, we can observe the large gap between maxillary and mandibular buccal cusps on the first molar.

The mandibular denture

The mandibular denture bearing area can have a difficult shape with many differently inclined levels. Everyone knows what happens if you stand on an inclined slope on ice or snow in Switzerland - we slide downhill without any effort, known as skiing! Teeth standing on the retro-molar ascending part of the ridge push the denture forward during mastication (Gysi 1917).[9] Figure 5 depicts a common case. The last mandibular molar is positioned in the area of the retro-molar ascending part of the ridge and the force to the mandibular denture during function is transmitted obliquely to this inclined retro-molar area. The force will be deflected forward and the denture slips down the slope and lifts up at the front.



Figures 9a and 9b. If sufficient space is lacking, we recommended not placing any maxillary second molars at all.

The maxillary denture

"Can this also happen with the maxillary denture?" Yes!

This case shows that both dentures are unstable (Figure 6). As the patient chews food, the dentures move making it virtually impossible to masticate. Pressure areas are pre-assigned and, with time, provoke resorption of the ridge. Under masticatory force, the maxillary denture slips forward and only the patient's lips hold the denture in position. This has a negative effect on aesthetics, making the lips appear tensed.

Model analysis

Anyone building a house knows that he has to analyse the ground it will be supported on. When setting up a denture, we need to do the same - we call it model-analysis. We draw the different zones on the side of the model - positive, neutral and negative/unstable areas. We use different colours to get a quick analysis of the situation (Figure 7).

Posterior tooth position

The second maxillary molar in Figure 8a and 8b is 3mm out of contact to its antagonist and therefore it is not possible to chew with it. These last teeth serve only as a support to the cheeks, prevent food slipping up or down under the denture and prevent cheek-biting.[10]

If sufficient space is lacking, we recommend not placing any maxillary second molars at all (Figures 9a and 9b).

Conclusion

Tooth position is a main contributing factor to stabilise dentures. Each tooth needs to be set-up such that functional forces are directed to the respective ridges and press the denture base orthogonally on the mucosal surface. This is also referred to as unilateral, multilocal chewing stability, i.e. dentures will be more stable when biting on just one side.

Part II of II

In part II we deal with the concept of balanced occlusion, establishment of centric relation and the use of an articulator that enhances functionality in denture wearers.

Acknowledgements

We thank Dr. A. Johnson, Mr. M. Boxhoorn for editing and Mrs. A. Bruelhart for her assistance with the translations.

About the authors

Max Bosshart is an internationally known Master Dental Technician and licensed Prosthesist who works in private practice in Einsiedeln, Switzerland and is an advisor and instructor at Condylator AG, Switzerland and Merz Dental, Germany.

Dr Matthias Bickel is former Professor of Prosthodontics at the University of Queensland and works in private practice as a Specialist Prosthodontics registered in Queensland and Switzerland. His special interest is in using the Gerber System to rehabilitate patients in need of fixed and removable dentures including implant overdentures.

References

1. Hiltebrandt, C.: Die physiologischen und statischen Grundlagen der totalen Prothese. Published byVita Zahnfabrik GmbH Essen; 1935.
2. Gerber, A.: Die artikuläre Funktion und die Schleimhautbelastung beim Kauen von Prothesen, Vortrag am SSO-Kongress in Lugano, 1946.
3. Gerber, A.: Beiträge zur Technologie in der totalen Prothetik I & II. Quintessenz der Zahntechnik12/ 1976; 11-21 & 3/1977; 12-21. Quintessenz Verlags GmbH Berlin. As well pblished 1977 by Quintessenz Chicago in english language.
4. Kimoto, S., Gunji, A.; Yamakava, A.; Ajiro H., Kanno, K., Shinomiya, M., Kawara, M., Kobayashi, K.: Prospective Clinical Trial Compairing Lingualized Occlusion to Bilateral Balanced Occlusion in Complete Dentures: A Pilot Study. Quintessence Publishing Co. Inc., Volume 19, Number 1, 2006; 103-109.
5. Ates, M., Cilingir, A., Sülün, T., Sünbulöoglu, E. Bozdag, E.: The effect of occlusal contact localisation on the stress distribution in complete maxillary denture. Journal of Oral Rehabilitation, 2006 33; 509-513. Blackwell Publishing Ltd.; Oxford.
6. Payne S.H.: A posterior set-up to meet individual requirements, >Dent.Dig. 1941,47: 20-22.
7. Gerber, A.: Okklusion und Artikulation in der Prothetik; 1960. Published by Condylator Service; Zurich.
8. Gerber, A.: Progress in full denture prosthesis. Int. Dental Journal 2/1957; 325.
9. Gysi, A.: Montage d'Appareils avec les Dents Anatoform et les Blocs Gysi, 12.7.1917; S. 28. De Trey & Co. Ltd. (A. Gysi, Sammelband III); Londres.
10. Bosshart, M.: Funktion des zweiten Molaren. Das Dental Labor, Heft 6/2007 (853-854); München.