

Advantages and Disadvantages of Constrained Plates (Set Angles) for the Anterior Stabilisation of the Anterior Cervical Spine

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This discussion is based on clinical experience and presents clinical data and films. I will not provide facts and data from experimental, biomechanical tests so as to support and to provide evidence for my opinion.

1. The presentation of the advantages and disadvantages of an implant implies the decision for or against a certain implant as per the discussion mentioned above. In my case this is not possible, since I am only referring to one out of three components, whereas all components should be discussed with their implied advantages and disadvantages. Nevertheless, it is important to understand the advantages of constrained systems and how this advantages can be used in the best ways and in which cases.
2. On principle, every cervical spine can be instrumented with every plate-screw system that is commercially available as long as it was designed for cervical application. The materials of all of them were tested appropriately, so the screws and plates do not break easily. However, a surgeon not only needs products made of quality raw material to standards whatsoever, he also has special expectations in regards to function and to the technical design of the material. On the one hand these are based on biomechanical, objective data and expectations in regards to the implant resulting thereof, and on the other hand and in opposition to that, they are based on the patho-physiological and physiological knowledge about bone morphology in each special case.

With this background in mind, a large number of plate-screw-constructs were developed. All of them were designed to improve the anterior cervical spine instrumentation. Necessary modifications especially referred to

- Improvement of the screw design (functionality) to avoid dislocation/implant loosening post-operatively
 - The instrumentation is to provide the best possible basis for a bony fusion, meaning the most effective immobilisation of the fusion and a
 - Safe screw placement by avoiding bicortical application of the screws.
3. Thus, the constrained plate was developed and within this product category a variety of different designs were developed. All of them make handling more easy and all of them follow the major feature of the 'constrained' implant.

All of the requirements to an implant were achieved, however, with the experience of several years, it became obvious that the requirements as described – complete immobilisation – are neither the best for every instrumentation nor imperative in every case. This means for our topic:

4. The reflections about advantages and disadvantages of a constrained plate must include a discussion of the indications and necessarily of the different plate-screw constructs. The development of different plate-screw-constructs (constrained, unconstrained, compression plates, plates with expandable screws) were necessary and arose as a consequence of biomechanical research and the different expectations to the implant (the user) in combination with the different indications (patient, beneficent).

For our purpose this necessarily means that advantages and disadvantages of constrained plates must only be seen in the light of the discussion about indications. The /true but theoretical/ definition restricted to advantages and disadvantages of design and function may be turned upside down in clinical application in some cases, meaning that a basic advantage becomes a disadvantage in certain circumstances or a common disadvantage suddenly proves to be advantageous.

Advantages and disadvantages of constrained plates do not refer to the choice of the surgeon to use the one or the other plate system, but to the user's awareness for the product, i.e. which is the indication and which is the patient-specific data that must be observed, how can the aim be achieved and how much does the result depend on the experience of the surgeon. In summary:

Which plate to choose best for the planned, individual surgery in every single case.

A. Advantages of the constrained plate

1. Constrained plates are fixed constructs as the best possible basis to avoid micromotion.
2. A constrained anchorage of the screw in the plate makes the application of monocortical screws possible.
 - a. Thus the requirements to the necessary basic set are reduced i.e. screws do not have to come in 2 mm increments, but a reduction to 2 or (at most) 3 different lengths as part of the set are sufficient (more economic and more user friendly).
 - b. Consequently, easy and safe handling often becomes possible, especially if radiological control is not possible due to the situation or due to individual features.

B. Disadvantages of the constrained plate

1. A constrained implant with a complete immobilisation is not always necessarily advantageous. With some bone dowels the 'remaining mobility' supports fusion, whereas the complete immobilisation is more likely to cause non-union.
2. Caused by the set, constrained angle of the screw-plate construct, the screw may lose purchase for instance in cases of poor bone quality. In the same circumstances non-constrained plates in combination with insufficiently anchored bicortical screws cause screw loosening and implant dislocation.

On the other hand constrained systems as a whole are backing out. The result is the same: The fixation does no longer exist.

3. Constrained constructs by definition determine the angle of the screws in respect to the plate when they are implanted into the vertebral body. Practically speaking, this means very narrow limits of how the screw must be inserted. This is sometimes impossible if the anatomical situation is difficult. Consequently, the anchorage of the screw is inappropriate, there will be no constrained fixation and consequently the advantages of the implants are lost.

C. Summary

A constrained plate should only be used, if there is the possibility to benefit from the plate's advantages, i.e.

1. if there is good exposure of the surgical/anatomical segment of the spine; in the best case 1 segment, or, at most, 2 segments as planned in cases of
2. good bone quality. Osteoporotic bone must be avoided and the
3. bone dowel must be (perfectly) fitting.

If those requirements are not fulfilled, the advantages of the constrained plate may be turned into disadvantages. In those cases other systems should be used.