

Clinical experience and results with a Rhombic Plate for transoral endoscopically-assisted osteosynthesis of fractures of the condylar neck

H. Leonhardt^{a,*}, A. Franke^a, A. Nowak^a, NMH. McLeod^b, G. Lauer^a

^a University Hospital Carl Gustav Carus at Technical University Dresden, Clinic of Maxillofacial Surgery, Fetscherstr. 74, 01309 Dresden, Germany

^b Barts Health NHS Trust, The Royal London Dental Hospital, Turner Street, Whitechapel, London, E1 1BB, United Kingdom

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Abstract

The intraoral approach is favoured by many patients and surgeons for the treatment of fractures of the condylar neck, but the limited space offered by this approach can make positioning and fixation of the osteosynthesis plate difficult. A rhombic-shaped plate was designed specifically for use with the intraoral approach, and introduced into our clinical practice in 2012. We present the clinical and functional results in 81 patients with 98 fractures of the condylar neck who we have treated with this technique. Of these six required surgical revision, and ultimately all but two had satisfactory occlusion and mandibular function. Our complication rate of 6/81 (7.4%) compares favourably with those reported elsewhere, and confirms that open reduction and internal fixation of condylar fractures using the Rhombic plate through an intra-oral approach provides good outcomes.

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Introduction

Open reduction and internal fixation (ORIF) of fractures of the mandibular condyle remains controversial, but provides the best outcomes in terms of function and occlusion.^{1–3} To achieve such good functional results requires anatomical reduction and suitable fixation that properly take account of the biomechanical forces on the condyle during function.⁴

Multiple surgical approaches to the mandibular condyle have been suggested, most of which are transcutaneous and provide good visibility and access to the fracture. However, they produce a scar, may result in problems with the salivary gland (sialocele or salivary fistula), and carry a risk

of injury to the facial nerve.⁵ The intraoral approach avoids these risks, but the access provided is more limited (particularly if you want to see the alignment of the posterior border and find space for manipulation of the plate and screws), and there is a greater learning curve.⁶ Nevertheless, in our experience (and despite the increased difficulties for the surgeon) many patients prefer an intraoral approach to avoid the complications of the extraoral approach.

There is plethora of osteosynthesis plates and patterns of fixation described for condylar fractures, and the use of 3-dimensional plates permits suitable fixation of the fracture using a single plate.^{4,7–10}

The Rhombic 3D Condylar Fracture plate (KLS Martin GmbH + Co) was specifically developed to be used with an endoscopically-assisted intraoral approach. We describe our experience and clinical results of four years' treatment of fractures with this plate.

* Corresponding author at: University Hospital Carl Gustav Carus at Technical University Dresden, Clinic of Maxillofacial Surgery, Fetscherstr. 74, 01309 Dresden, Germany. Tel.: +0049 351 458 5205; Fax: +0049 351 458.

E-mail address: Henry.Leonhardt@uniklinikum-dresden.de (H. Leonhardt).

Material and methods

Operative technique

Our criteria for the use of an intraoral approach for ORIF of condylar fractures is principally based on the position of the fracture, with type II and IV fractures (as described by Spiessl and Schroll) generally suitable.¹¹

Our surgical technique is as described by Lauer et al, Jeter et al, and Undt et al.^{9,12,13} In most cases the plate can be inserted without adaptation but, on occasion, a slight bending of the plate is required to allow for the curvature of the mandibular condyle. The screw in the hole proximal to the fracture in the condylar fragment is normally inserted first. We use an angled screwdriver for the treatment of all fractures in this study (Angled Screwdriver, Hauenstein) but transbuccal insertion of the screw with a trocar may serve as an alternative to facilitate the handling for a less experienced surgeon. Postoperative IMF is necessary only if there is a joint effusion. The patients were given standard exercises to improve the movement of the mandible starting four weeks postoperatively.

Postoperative follow up and treatment

The patients were enrolled in a follow-up programme, during which they were reviewed at two weeks, four weeks, three months, and six months postoperatively. The occlusion was reviewed subjectively, and mouth opening, laterotrusion, and protrusion were measured.

The study followed the medical protocol and ethics of the Declaration of Helsinki, and the local Ethics Review Board of the University Clinic of Dresden approved the study (EK 170042015).

Results

From May 2012 to December 2016 we treated 81 patients (55 male and 26 female) with 98 condylar fractures. Their mean age was 39 years (range 15–88).

Eighty-six of the 98 fractures were treated through an intraoral approach. Six contralateral fractures were treated by an extraoral approach with the Rhombic plate because the fracture was higher up in the condylar neck (Spiessl and Schroll class III and V). One contralateral fracture was treated with a lag screw and one with two miniplates. The other four fractures were fractures of the condylar head treated by ORIF with headless bone screws.^{14,15}

Non-attendance at follow up was highest at six months, when 27/81 patients attended for review.

In general, the occlusion was good directly after the operation, with temporary disturbances immediately postoperatively related to temporomandibular joint (TMJ) effusions treated with elastic intermaxillary fixation. After six months all but two patients had good occlusions.

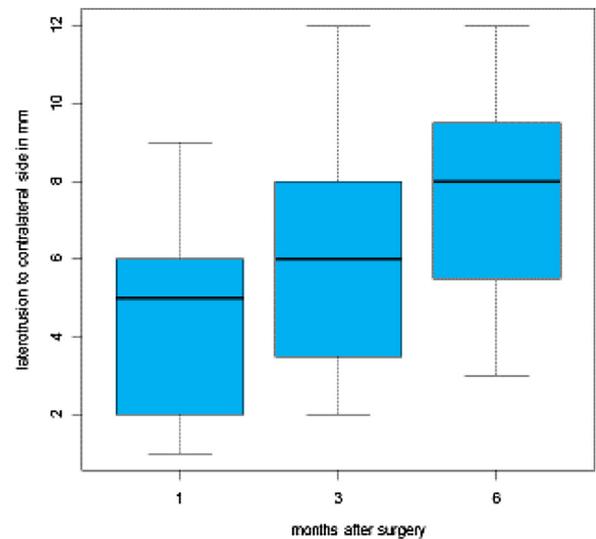


Fig. 1. Laterotrusion to the contralateral side of the fracture.

In one case, the patient had insisted on an intraoral approach despite our advice that the fracture was not suitable, and after an intraoral revision a persistent discrete open bite of 0.5 mm resulted.

A second patient was sent back by his dentist after six months with failed osteosynthesis, with the screws extruded from the fragment of the condylar head. We removed the plate and did a reosteosynthesis, after which the patient had an adequate functional occlusion. Overall, we had to revise six operations after primary treatment, including the two patients with malocclusion.

In two elderly patients revisions were necessary through an extraoral approach as the screws in the distal mandibular fragment had stripped out of the osteoporotic bone. In two other cases, the intraoral reduction was not satisfactory despite endoscopic assistance. Immediately after the postoperative radiographic control we revised the repairs, with good postoperative results.

Patients commonly complained of reduced mouth opening postoperatively, but less so of lateral and protrusive movements. Over the six months' follow-up period there was a significant improvement in all movements ($p < 0.005$), with mean mouth opening of 42.9 mm, laterotrusion to the contralateral side (from the fracture) of 7.9 mm and protrusion of 8.6 mm, which are within the normal ranges (Figs. 1–3).¹⁶

In general, we do not remove osteosynthesis material, but seven patients insisted that we removed the plates, which we did after six months.

Further side effects developed after repair of the fractures: four patients complained of muscular tension during the postoperative period, which improved with physiotherapy. Four others reported clicking of the TMJ, which was persistent over time. One intraoral scar had to be corrected when the osteosynthesis material was removed; one patient had wound healing problems; and six patients reported hypoaesthesia of the distribution of the long buccal nerve in the inner cheek.

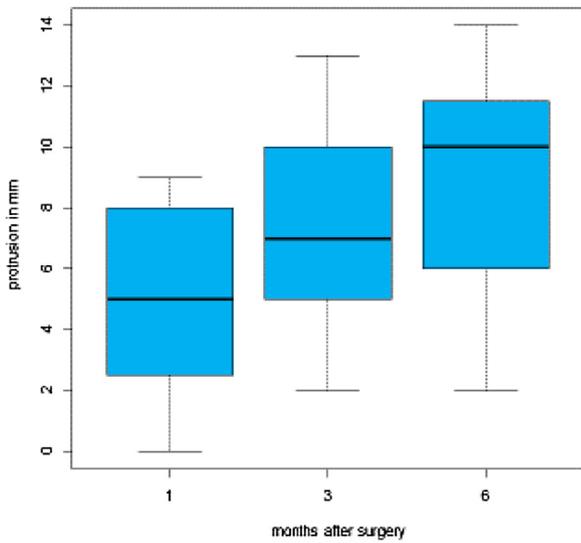


Fig. 2. Protrusion.

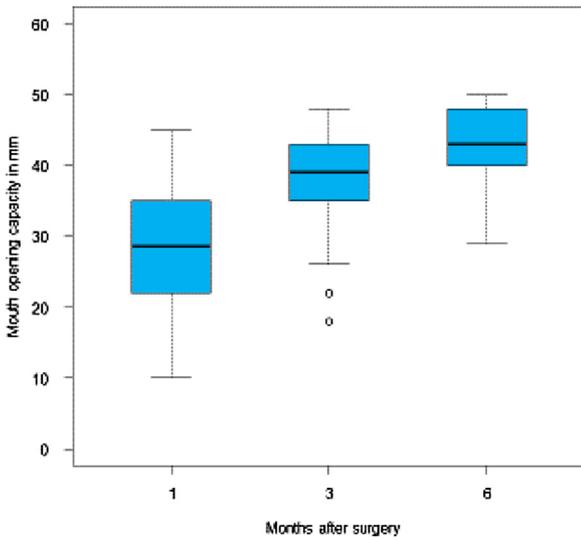


Fig. 3. Mouth-opening capacity.

Discussion

A number of reported studies have examined the biomechanical stability of different plate designs for fixation of fractures of the mandibular condyle, most of which were done in vitro, with relatively few studies reporting outcomes in vivo.⁶ In general, it is easier to place a single 3-dimensional plate than two single plates, particularly with higher fractures.

The Rhombic plate has been specifically designed with an intraoral surgical approach in mind. It allows for placement of two holes in the proximal fragment and three in the distal fragment, which aids manipulation of the fracture to obtain a good anatomical reduction, and the split lower arms ensure good biomechanical control of the fracture (Figs. 4–6). There is also a large central window that allows direct visualisation of the fracture to control the reduction, although it is

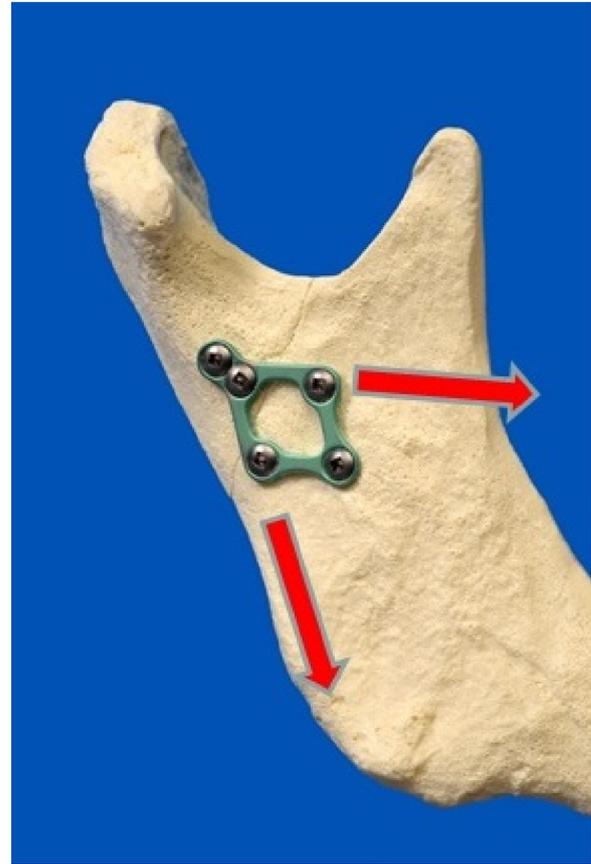


Fig. 4. Rhombic plate providing a stable two-vector fixation of fractures of the condylar neck.

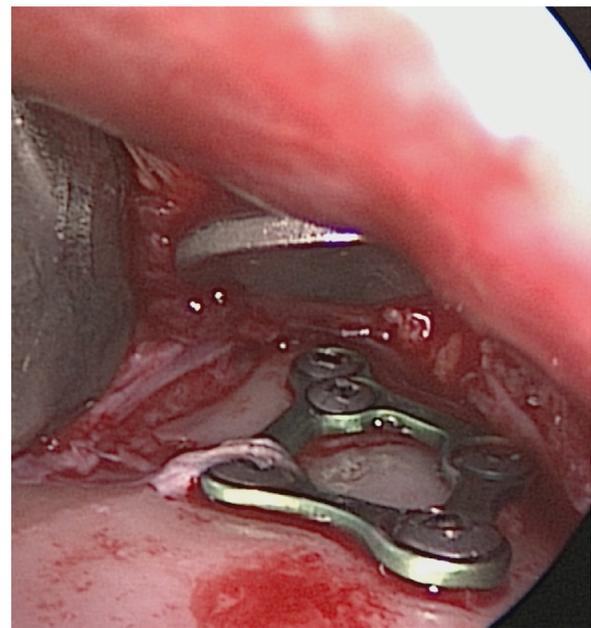


Fig. 5. Endoscopic view of the Rhombic plate in situ.



Fig. 6. Postoperative orthopantogram.

less than when two separate miniplates are used for fixation. Sometimes this makes it difficult to assess the reduction as the screw holes are drilled.

There are two versions of the plate: the Rhombic 3D Gliding-Reposition plate for normal osteosynthesis screws, and the Rhombic 3D ThreadLock TS plate for locking screws (but which can also be used with standard screws). We prefer to use the slightly more rigid locking Rhombic 3D ThreadLock TS plate with normal 2.0 miniscrews rather than locking screws, as we think that the use of locking screws can hinder the proper alignment of the fracture and the stability of the fixation as the screw may lock in the plate before the plate abuts on the bone.⁶ Overall, published reports show that the clinical results concerning stability, occlusion, and postoperative complications are similar whether locking or non-locking plates are used.¹⁷

All but two patients had a satisfactory occlusion after four weeks of follow up (when any joint effusion had resolved), and at the six-month follow up no new problems with occlusion were reported. Rigid internal fixation of condylar fractures with 3-dimensional plates gives good functional results, and ours indicate therefore that the Rhombic plate can provide the biomechanical stability necessary for fixation of mandibular condylar fractures.^{5,7,9}

For open reduction and internal rigid fixation of condylar fractures the intraoral approach has several advantages: it avoids a scar on the facial skin and it minimises the risk of facial nerve palsy. However, because of the limited space and visibility, surgical experience is a prerequisite to successful ORIF through this approach, including the handling of an angled screwdriver and endoscopic assistance.^{18,19}

Higher fractures, medially-displaced proximal fragments (particularly where there is a long condylar neck) can be particularly difficult and are best undertaken by surgeons experienced at intraoral fixation of condylar fractures. Keeping these facts in mind the Rhombic plate was primarily designed for the intraoral approach as it allows for enough

visibility and control of fracture reduction and osteosynthesis while in situ.

Our data confirm that this plate can be used successfully in clinical practice, and in the vast majority of our cases ORIF was possible purely through this intraoral approach.

Of the six patients whose operations required surgical revision, three had inadequate reduction of the fracture, of which one had been predicted to be “difficult” preoperatively. It is important that the reduction is adequately assessed intraoperatively, as if the revision is seen to be inadequate it should be revised there and then. It is important to be able to convert to an extraoral approach if necessary (to avoid the need for a second operation) when an adequate reduction or fixation cannot be achieved intraorally.

Two patients whose fixation failed were elderly, and in both the three lower screws had pulled out of the bone of the distal fragment and caused the fracture to slip. On review of these cases, two problems seemed to be apparent: the patients had mild osteoporosis, and the reduction of the fracture was not perfect. In addition, both patients had insufficient dental posterior occlusal support, which created additional functional stresses on the condylar neck compared with fully dentate patients, and in such cases bicortical fixation of the plate and more careful control of the reduction may have prevented the problem.

Finally, there was one patient in whom fixation of the proximal screw failed, with no obvious cause. We speculated that the reduction of the fracture may not have been as anatomically correct 3-dimensionally as it seemed to be on our postoperative radiographs, or the patient may have had parafunctional habits which put abnormal or excessive loads on the condyle.

Among those with complications, there were four patients with painful tightness of the muscles and four with persistent clicking of the TMJ. The muscular tightness could have been caused by scars in the muscles or small changes in the musculoskeletal system of the TMJ and, while this is common

immediately after ORIF of condylar fractures, it will normally resolve within six months.²⁰ Clicking of the TMJ can arise after trauma to the mandible as a result of displacement of the intra-articular disc, and is not often associated with appreciable symptoms. In patients with symptoms such as pain, or locking of the TMJ, surgical correction may be indicated.

Kokemueller et al estimated the risk of postoperative complications to be 19% after operative treatment of condylar neck fractures through an intraoral approach.²⁰ The rate of major complications of 6/81 (7.4%) in our series in which the Rhombic plate was inserted using an endoscopically-assisted intraoral approach is less than this, and we think that it confirms the suitability of the technique.

Conclusion

The clinical introduction of the Rhombic plate facilitates the intraoral osteosynthesis of fractures of the condylar neck and leads to biomechanical stability as well as good functional results. It can be combined with the use of an angled screwdriver and endoscopic assistance. Considering the limitations of the intraoral approach the treatment of condylar neck fractures with the Rhombic plate using an endoscopically-assisted intraoral approach proved to be a safe technique that gave a low rate of complications, particularly when there was good anatomical reduction of the fracture.

Conflict of interest

Günter Lauer received an honorarium from KLS Martin, the producer of the Rhombus Plate. The other authors have no conflicts of interest.

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