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ORIGINAL ARTICLE

Use of Two Lag Screws for ORIF of Mandibular Condylar Sagittal Split fracture: An Anti-rotational Concept—A Prospective Clinical Trial

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Abstract

Background Condylar process fracture is one of the most common mandibular fractures. Approximately 11–16% of all facial fractures and 30–40% of all mandibular fractures are fractures of the mandibular condyle. Treatment can broadly be divided into open or closed, but there are no clear criteria to determine the choice between them. Sagittal split fracture of the mandibular condyle is rare and can be easily missed on conventional radiographs, like OPG and multiple standard films, but because of the high incidence of subsequent ankylosis is an important entity. So a CT scan with axial and coronal cuts is advisable in high condylar or intracapsular fractures of mandibular condyle.

Purpose The hypothesis in this study is that open reduction and internal fixation (ORIF) of sagittal split mandibular condylar fractures with two lag screws is more stable and there is no rotation of the medial fractured segment of condyle.

Methods In this prospective clinical trial, ORIF of four patients with sagittal split fracture of mandibular condyle was done using two lag screws. In all the patients, pre-op and post-op clinical and radiological findings were evaluated, with a follow-up of two years.

Results All the patients were evaluated postoperatively at periodical interval with various clinical parameters, viz. mouth opening, occlusion, pain, deviation of mandible while opening, other complaints (like clicking, tenderness), and radiologically with CT scans. All patients showed good occlusion and adequate mouth opening postoperatively. In this series, there was no pain, deviation of mandible while opening and other complaints like tenderness and clicking. In CT scan, the medial fragment was reduced anatomically in position and the lag screws were not protruding in the TM joint space.

Conclusion Use of two lag screws for ORIF of sagittal split mandibular condylar fractures is recommended to prevent the rotation of fractured medial condylar segment and for more stable fixation.

Keywords Sagittal split · Condylar fractures · Two lag screws

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Introduction

Mandibular fractures are the most common facial fractures, and among these, fractures of the condylar and subcondylar region are a clinical challenge. Condylar process fracture is also one of the most common mandibular fractures, and it involves about 25–30% of all mandibular fractures [1].

Treatment of mandibular condyle fractures is still a matter of controversy, with surgical treatment slowly gaining ground over conservative treatment as the

preferred option. However, intra-articular (diacapitular) condyle fractures are still treated conservatively at many institutions, including those that treat extra articular fractures (i.e. condylar neck and subcondylar fractures) surgically.

Sagittal split fracture of the mandibular condyle is a vertical fracture involving condylar head and condylar capsule. Sagittal split fracture of the mandibular condyle is rare and can be easily missed on conventional radiographs, like OPG and multiple standard films, but because of the high incidence of subsequent ankylosis it is an important entity. As radiographic techniques improve, so do the diagnosis and classification of sagittal split fracture of mandibular condyle [2–4].

Very few studies are available on treatment of sagittal split fracture of mandibular condyle. With the case series of four patients operated at our centre, we hereby advocate fixation of sagittal split condyle fracture using two lag screws.

Surgical Technique

All the four patients reported in our OPD with the history of trauma to mandible due to road traffic accident. The signs and symptoms were painful and restricted mouth opening, slight deviation of mandible towards the fractured side while opening, pain while chewing food and unable to eat hard food. There was tenderness over the fractured side condylar region, and occlusion was not complete, mild open bite (Fig. 1). Patient's OPG radiographs were not showing any signs of mandibular condyle fracture. Detailed clinical examination raised the suspicion of injury to mandibular condyle, so CT scans were advised in all patients. The CT scans clearly showed the sagittal split fracture of the mandibular condyle, which was displaced significantly (Fig. 2).

Fig. 1 Pre-op photograph showing disturbed occlusion and restricted mouth opening

In all the cases, the sagittal split fracture was approached through standard pre-auricular incision of approximate 2.5 to 3 cm in length. Layer-wise dissection was performed preserving the superficial temporal vessels and the temporal branch of facial nerve, which is the only important nerve in this region, which usually crosses the middle section of zygomatic arch to the temporal region [5]. An incision of 1.5 to 2 cm in length was made to open the articular capsule and reveal the condyle process along the posterior border of the condyle process in the posterior condylar area. After entering the TMJ capsule, the medial fragment is usually very difficult to locate. The downward pull of mandible by transcutaneous clamp at the angle region was very helpful for us, in gaining the access to that medial fragment; we usually follow this method. A blunt probe or blunt end of periosteal elevator is used to feel and locate the medial fragment. With the help of the periosteal elevator, the medial fragment is anatomically reduced in position (Fig. 3), and we also used condylar retractor to keep the medial fragment in the reduced position. The advantage of using condylar retractor is to protect the vital structures medial to the condyle from injuring with the drill bit, also preventing the lag screw from penetrating outside the condyle into the TM joint space. The pull of the fibres of the lateral pterygoid muscle makes it very difficult to reduce it completely. Due care should be taken to avoid stripping of the muscle from the fragment, as it may compromise the blood circulation of that isolated fragment. Complete muscle relaxation under general anaesthesia will help in reduction. After reduction in the medial fragment, inter-maxillary fixation applied temporarily to the arch bars to maintain the occlusion. It is critical to maintain the medial fragment in fixed position during the drilling of the hole and the insertion of titanium screws. Two lag screws are inserted parallel to each other across the sagittal fracture engaging the medial condylar fragment (Fig. 4). The screws were tightened gently to compress the inter-fragmentary gap of the fracture site. Care should be taken that the screw should not penetrate outside from the condyle into the TM joint space. The lag screw we used was of 2 mm in diameter and of lengths 16 mm and 18 mm. The measurements were taken previously from CT (coronal cuts) also by measuring from the opposite side nonfractured condyle. The inter-maxillary fixation was released. After verifying that the articular disc was in correct position, the capsule was carefully sutured and the surgical site closed in layers.

Post-op CT scans were performed after 3 days. The post-op CT showed anatomical reduction in fractured medial segment of condyle with two lag screws, within the confines of the condyle, not protruding out into the TM

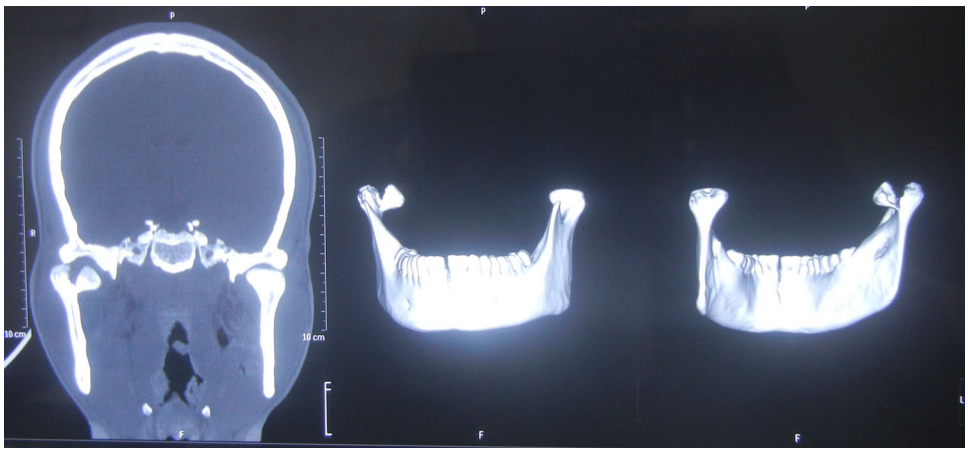

Fig. 2 Pre-op CT, sagittal split fracture, displaced medial fragment

Fig. 3 Intra-op photograph showing medial condylar split

joint space. (Figure 5) If the screw is seen popping out of condyle into joint space, that screw should be removed, as it may interfere with the jaw mobility and function. Long-term follow-up of about 2 years of our patients showed good occlusion, no mandibular deviation on mouth opening, no restriction in mouth opening and lateral movements of mandible and no other complaints (Figs. 6, 7, 8). The main purpose of using two lag screws is to prevent rotation of the medial fragment during functional jaw movements, and also it provides more stability to fracture.

The expected intraoperative and postoperative complications which may be encountered in this surgery are common to those which would occur in any other surgery

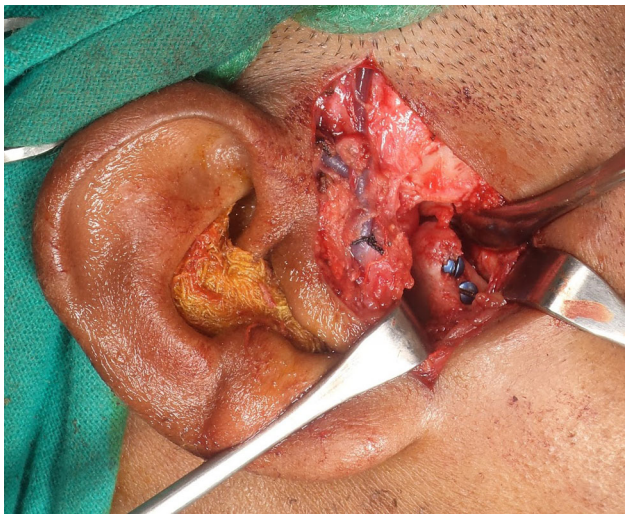

Fig. 4 Intra-op photograph showing fixation with two lag screws

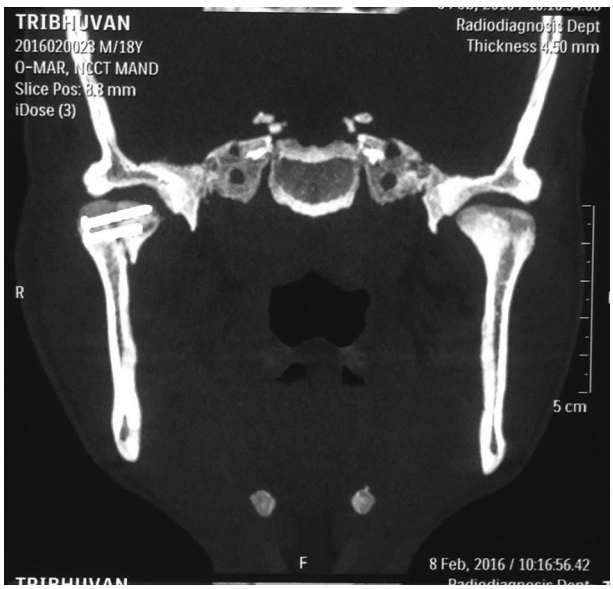

Fig. 5 Post-op CT showing anatomically reduced medial fragment

Fig. 6 Post-op mouth opening unhindered and no deviation

Fig. 7 Post-op occlusion

to condyle and ramus area like facial nerve injury, external auditory canal injury.

However, certain specific complications which may be expected with this technique are:

1. Penetration of screws on medial side. This is not a major complication and will not affect the jaw movements. This can be avoided by selection of proper length of the screws with the help of CT scans (coronal sections) also by measuring from the opposite side nonfractured condyle.
2. Penetration into TM joint space. If this occurs, the screw has to be removed. This is avoided by proper angulation while inserting the screw.
3. Avascular necrosis of the medial condylar head is a very rare possibility. It can be totally avoided by careful handling of the medial condylar segment and not stripping of the attachment of lateral pterygoid muscle.

Fig. 8 Post-op facial profile view, no scar visible

In our series of four patients, we have not encountered any of the above complications.

The only limitation of our study is the sagittal split fractures are not very common to find. We have operated four patients with this technique, and our study is still going on, and we will publish again with larger numbers of patients.

Postoperative follow-up							
Parameters		1 week	1 month	3 months	6 months	1 year	2 year
Mouth opening (MIO)*	Patient 1	++	+++	+++	+++	+++	+++
	Patient 2	++	+++	+++	+++	+++	+++
	Patient 3	+++	+++	+++	+++	+++	+++
	Patient 4	++	+++	+++	+++	+++	+++
Occlusion	Patient 1	−	+	+	+	+	+
	Patient 2	+	+	+	+	+	+
	Patient 3	−	+	+	+	+	+
	Patient 4	+	+	+	+	+	+
Pain	Patient 1	−	−	−	−	−	−
	Patient 2	+	−	−	−	−	−
	Patient 3	−	−	−	−	−	−
	Patient 4	+	−	−	−	−	−
Deviation of mandible while opening	Patient 1	+	−	−	−	−	−−
	Patient 2	−	−	−	−	−	−
	Patient 3	−	−	−	−	−	−
	Patient 4	+	−	−	−	−	−
Any other complaints (clicking, tenderness)	Patient 1	−	−−	−	−	−	−
	Patient 2	−	−	−	−	−	−
	Patient 3	−	−	−	−	−	−
	Patient 4	−	−	−	−	−	−

Mouth opening (maximum inter-incisal opening)—(+ severely restricted < 25 mm), (++ restricted 25–35 mm), (+++ adequate > 35 mm)
Occlusion—(−—malocclusion needing re-operation,—mild malocclusion, + recovery to previous occlusion)
Pain—(Visual Analogue Scale(VAS)—0, + 1–4 mild pain, ++ 4–7 moderate pain, +++ 8-10 severe pain)
Deviation—(no deviation −, slight deviation +, severe deviation ++)

Discussion

Sagittal split fracture of the mandibular condyle (SFMC) is a vertical fracture involving condylar head and condylar capsule. The joint capsule is torn, and the lateral pterygoid muscle exerts traction on the fractured fragment, thereby displacing or dislocating it away from its original position. It is also called as intracapsular (diacapitular) condylar fracture. With the improvement in radiographic diagnostics, especially computer tomography (CT) scanning, the observed incidence of sagittal condylar fractures has gradually increased in recent years.

Classification of SFMCs (Fig. 9)

The posterior plane of the condylar head was divided into three vertical sections equally. They were the medial section, central section and lateral section, respectively. SFMCs were distinguished into type M (medial), type C (central) and type L (lateral) according the location of the fracture line within the sections (Fig. 4) [6]. According to this classification, our patient was having type C or central sagittal split mandibular condyle fracture.

The main complaints are restriction of mandibular movements and deranged occlusion caused by a dislocated fragment of fracture and shortened mandibular ramus. Nonsurgical treatments cannot correctly reposition the dislocated fragment of fracture and restore the normal length of the mandibular ramus; also the dislocated fragment of the fracture is associated with serious complications including TM joint ankylosis.

Vertical intracapsular condylar fracture was likely to result in osteoarthritis and ankylosis in sheep TMJ [10]. The study in humans of exploring the association between condylar fractures and TMJ ankylosis showed that 25 of 40 patients with ankylosis were the result of sagittal fractures of the condyle.

In recent years, various surgical treatments have been developed [4, 6–9] to treat sagittal condylar fractures. These techniques have disadvantages, including the technical complications of anatomical reduction and the instability of the reduced fracture fragment. To overcome these shortcomings, we tried a different surgical technique that uses two lag screws parallel to each other for the fixation of sagittal split condylar fracture and evaluated its treatment outcomes. The purpose of placing second lag

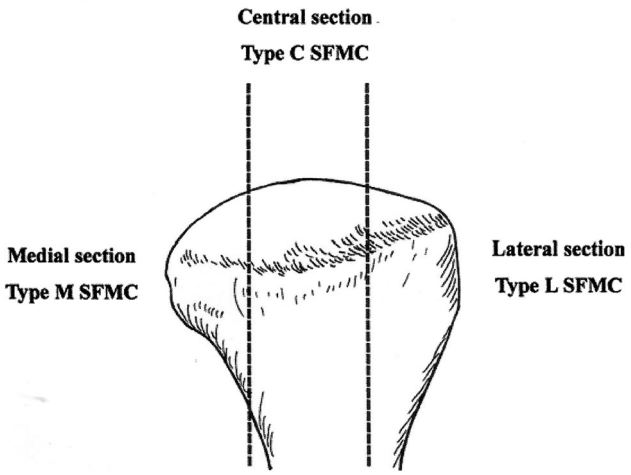

Fig. 9 Classification of SMFC (condylar head of the right side). The posterior plane of the condylar head was divided into three vertical sections equally. They were the medial section, central section and lateral section, respectively. SFMCs were distinguished into type M (medial), type C (central) and type L (lateral) according to the location of the fracture line within the sections [6]

screw was to prevent the rotation of the fractured fragment during function movement of mandible and also to increase the stability of the internal fixation. The post-op CT showed anatomical reduction, and the screws are within the confines of the condyle not protruding out in the TM joint space. Patients were not having any complaints, their occlusion was maintained and with follow-up of nearly 2 years patients were symptom-free.

Conclusion

Sagittal split condylar fracture of mandible can be easily missed in conventional radiographs, so CT scan is a must for a patient having trauma in mandible and if clinical examination raised suspicion of injury in condylar region. Use of two lag screws is recommended as an anti-rotational component. We now regularly use this technique to treat patients with sagittal split mandibular condylar fractures. We found this technique very effective in preventing the rotation of the medial component of the fractured condyle and stabilising it. With 2-year follow-up, we found that the functional and clinical outcome is good with good mouth opening, good occlusion, no deviation of mandible on opening and no other complaints like pain and clicking of temporomandibular joint.

Compliance with Ethical Standards

Conflict of interest All the three authors declare no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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