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Surgical Management of Long Standing Fibrous Ankylosis Secondary to Mandibular Condyle Intracranial Dislocation

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Abstract

Background and objectives: Displacement of the mandibular condyle into the middle cranial fossa is rare with 72 reported cases. Management options for mandibular condyle intracranial dislocation (MCID) includes surveillance, closed reduction or open reduction with or without craniotomy. The authors present a case of surgical management for longstanding MCID.

Case Report: We present the longest reported delayed diagnosis of MCID with surgical management involving temporomandibular joint (TMJ) gap arthroplasty, reconstructed with a composite transpositional temporal myofascial flap, with bilateral coronoidectomies.

Results: The patient's maximal incisal opening (MIO) improved from 11 mm pre-operatively to 20 mm immediately post-operation, and subsequently to 39 mm over 3-months with TMJ physiotherapy. This was sustained at 12-month review.

Conclusions: Management of longstanding MCID with TMJ gap arthroplasty, reconstructed with a composite transpositional temporal myofascial flap, with bilateral coronoidectomies provides long term improvement in MIO. This review provides clinicians with evidence and guidance for the delayed management of MCID with fibrous ankylosis.

Introduction

Condylar fractures account for 27-43% of all mandibular fractures (He et al. 2015). Displacement of the mandibular condyle (MC) into the middle cranial fossa (MCF) is rare with only 72 cases reported (Díez-Suárez and Paredes-Farrera 2021). Of the cases of mandibular condyle intracranial dislocation (MCID) reported, there is a female predilection (68%), with an average age of 23 years, no ethnic predisposition and a mean diagnosis of 31 days (Kanno et al. 2016; Díez-Suárez and Paredes-Farrera 2021). The primarily aetiology is high impact traumatic forces such as motor vehicle accidents (54%), bicycle crashes (25%) and falls (10%) with impact to the chin or contralateral mandible (Monteiro et al. 2019a; Díez-Suárez and Paredes-Farrera 2021). Risk factors for MCID include a rounded MC anatomy (2.8% of the population), thin glenoid fossa (normal 0.8 mm), direct impact of the mandible with an open jaw position, pneumatisation of the temporal bone, and a mandibular Kennedy Class I occlusion (Kanno et al. 2016).

Upon high impact forces to the mandible there are protective structures and mechanisms that exist to dissipate the condylar forces–these include; posterior dentition, articular disc, thin condylar neck (that is prone to fracture) accentuated lateral and medial poles of the condyles buttressing against the glenoid fossa and muscle attachments (Barron et al. 2002). However, for patients with a rounded condyle there is less surface area for ligamentous and musculature attachment, with reduced surface area against the glenoid fossa, and in the absence of posterior occlusal force dissipation, or an open mouth position, there are increased force in the superior direction, increasing the risk of MCID (Barron et al. 2002; Arya and Chigurupati 2016).

Diagnosis of MCID dislocation is based on clinical and radiographic examination (Kroetsch et al. 2001). Clinically patients may present with mandibular immobility (normal range 40–60 mm), laterognathism, unilateral open bite with contralateral crossbite, malocclusion, lack of mandibular excursion (normal range 10–15 mm), soft tissue lacerations, otalgia, cerebral spinal fluid otorrhea, otorrhagia, cranial nerve VII and VIII dysfunction, vertigo, nausea and seizures (Arya and Chigurupati 2016; Kanno et al. 2016; Díez-Suárez and Paredes-Farrera 2021). Concomitant injuries reported include facial (42%) and basilar skull fractures (10%), cerebral contusion (10%), concussion (7%), dural tear (4%) and subdural (29%) and epidural (7%) haematoma associated with posterior cerebral and middle meningeal haemorrhage, respectively (Barron et al. 2002; Díez-Suárez and Paredes-Farrera 2021). Two-dimensional imaging such as dental panoramic radiography and posterior-anterior mandible views have geometrical distortion and anatomical superimposition, making it difficult to interpret condylar position (Barron et al. 2002; Pinares and Urzúa 2016). With insufficient imaging underdiagnosis is common, with half of cases not diagnosed at first presentation. (Barron et al. 2002; Zamorano et al. 2016). Therefore computer tomography (CT) and magnetic resonance imaging (MRI) are the gold standard for diagnosis with high specificity and sensitivity, permitting the distinction of osseous and soft tissues of the condyle and intracranially, respectively (Pinares and Urzúa 2016). CT is crucial for diagnosis and treatment planning, determining the depth of MC protrusion and identifying the presence of incarceration. CT is also used immediately post-operatively to exclude neurological injuries and long term to identify causes of ankylosis, malocclusion and facial asymmetry (He et al. 2015).

Case Report

The authors present a 38-year-old female who was referred to the Oral and Maxillofacial Surgery Unit at Waikato Hospital New Zealand, with restricted maximum incisal opening (MIO) and left sided pre-auricular pain following a high-speed motorbike accident in Vietnam, 18 years prior. Initially in Vietnam she was diagnosed with an isolated mandibular symphysis fracture, which was managed with open reduction and internal fixation. Post-operatively she had noted progressive reduction in MIO, which had led to soft diet restrictions, inability to conduct optimal oral hygiene, access dental services and leading to the development of generalised dental caries.

On examination the patient had no facial asymmetry and normal cranial nerve and neurological examination. On palpation of the temporomandibular joint (TMJ) there was no translation of the left mandibular condyle on MIO, with generalised pre-auricular and myofascial pain. Intraoral examination identified a MIO of 10 mm, lateral excursive movement of 5 mm to the right and 2 mm to the left, with 2 mm mandibular midline left sided deviation on maximal opening (Figure 1). In centric relation there was left sided cross bite.

Panoramic radiography showed a superiorly displaced left MC, with hyperplastic sclerosis and generalised caries in the dentition (Figure 2). CT imaging identified fragmentation of the left mandibular condyle, with degenerative expansile subchondral sclerosis, displacement (18 mm) into the MCF with incarceration (Figure 3). MRI further identified impingement of the inferior temporal gyrus with associated haemosiderin and cortical encephalomalacia indicative of trauma. The disc was not identifiable, but myotendinous muscles fibres of the lateral pterygoid were present, along with 1-2 mL of joint fluid. Functional MRI confirmed fibrous ankylosis without condylar translation (Figure 4).

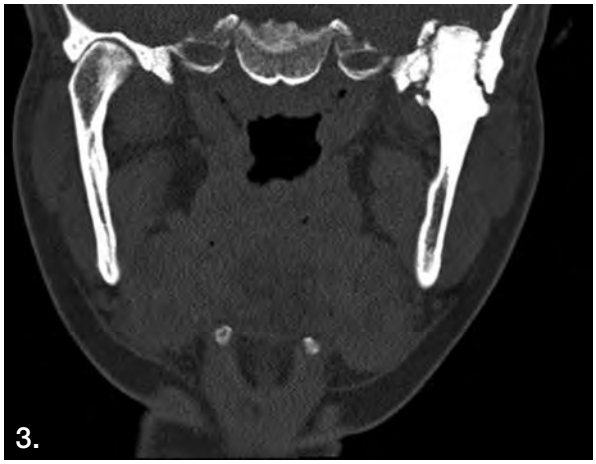
Surgical management under general anaesthesia (awake fibreoptic nasal intubation) involved left sided TMJ gap arthroplasty via an Al Kayat and Bramley incision, reconstructed with a composite transpositional temporal myofascial flap, along with bilateral coronoidectomies, intermaxillary fixation screws and dental extractions. On direct visualisation, the mandibular condyle had undergone fibrous expansile ankylosis with dislocation through the glenoid fossa into the middle cranial fossa. Upon bimanual manipulation condylar rotation and translation was unable to be elicited. Gap arthroplasty (10 mm) along with subcondylar recontouring allowed for rotation and translation improving the MIO to 45 mm. The dislocated superior mandibular condylar process was left in situ (Figure 5). Reconstruction was completed with an anterior and inferiorly-based temporalis flap 20 mm in width, extended 50 mm superior-inferiorly from the zygomatic arch. Medially the flap was dissected subperiosteally. The temporalis flap was tunnelled underneath the zygomatic arch using silk traction sutures, without osteotomy (Figure 6). The flap was secured with 5-0 polyglycolic acid sutures, two sutures in the anterior, middle and posterior capsular regions, respectively. Upon closure, a suction drain was placed and used for 24 hours, and IMF screws were placed in all four quadrants adjacent to the premolar teeth. The patient was discharged after 24 hours with post-operative elastics, antibiotics (topical and systemic), analgesia with no restriction on diet.

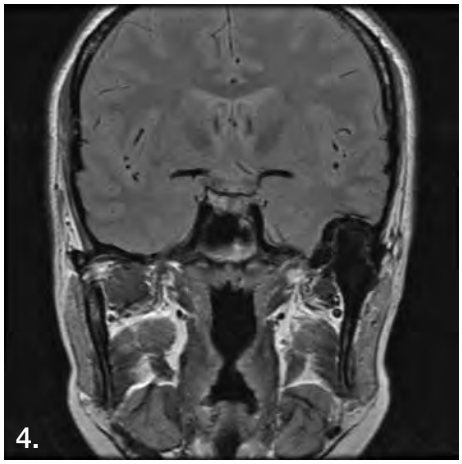
The patient presented at one week with MIO of 20 mm, 1 mm mandibular deviation on MIO, bilateral posterior contacts on centric occlusion without cross bite, with no neurological or cranial nerve deficit, facial asymmetry or cosmetic concerns. At 2 weeks post operation, the patient had the IMF screws and elastics removed, and initiated intensive TMJ physiotherapy using a TheraBite® Jaw Motion Rehabilitation System (Hörby, Sweden). Physiotherapy involved mandibular opening exercises for 2-3 minutes, 3-5 times per day for 3 months, with maximal recordings taken daily. Improvement in MIO is documented in Figure 7, with MIO at 3-months of 39 mm (Figure 8). This was maintained at a 12-month review.

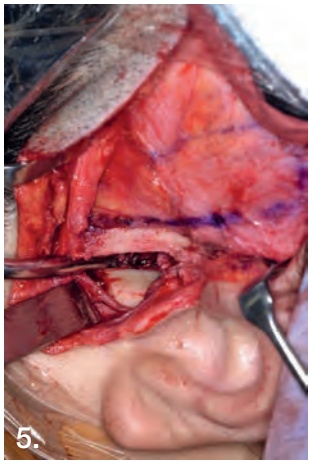
Discussion

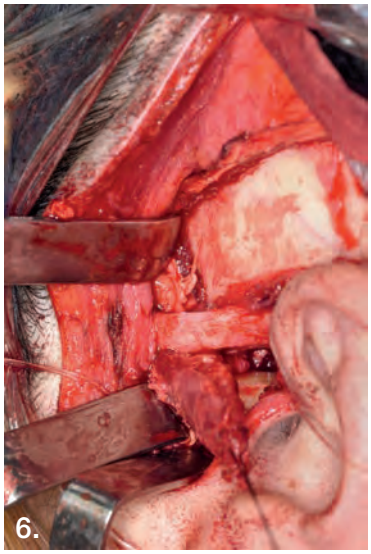
Management options for MCID includes surveillance, closed reduction or open reduction with or without craniotomy (He et al. 2015). The aims of treatment are to prevent, minimise or manage neurological injury, reduce the condyle in the glenoid fossa, restore occlusion and normal anatomical mandibular position and function, prevent displacement after reduction, and reduce growth restriction (Arya and Chigurupati 2016; Díez-Suárez and Paredes-Farrera 2021). Treatment is dictated by the age of the patient, time from injury to diagnosis and management, aetiology of the injury, and concomitant intracranial, neurological or associated injuries (Arya and Chigurupati 2016). Failure to provide prompt diagnosis and treatment can result in complications such as pterygoid or temporalis muscle contraction and fibrosis, joint ankylosis (fibrous, fibro-osseous, osseous), malocclusion, dentofacial asymmetry, chronic facial pain, and palsy of cranial nerves VII and VIII (Arya and Chigurupati 2016; de Mol et al. 2017; Liau et al. 2019; Monteiro et al. 2019a; Díez-Suárez and Paredes-Farrera 2021).

Closed reduction is performed primarily in patients who are young, with early diagnosis, without signs of mechanical ankylosis or condylar fracture, and in the absence of traumatic neurological or vascular injuries (Díez-Suárez and Paredes-Farrera 2021). Closed reduction should be considered for all cases in the absence of neurological contraindications (Zhang et al. 2016). Techniques used in closed reduction include bimanual dis-impaction, or the use of clamps, hooks or wire at the angle of the mandible to apply traction in a posterior-inferior direction. Alternatively, a Molt or Fergusson mouth prop can be used with a lever technique on the posterior dentition to dis-impact the condyle (Arya and Chigurupati 2016). The benefits of using a closed reduction procedure include the requirement for a less invasive procedure, reducing the risks of iatrogenic injury and growth disturbance, with less operative time and hospital stay (Arya and Chigurupati 2016). However, closed









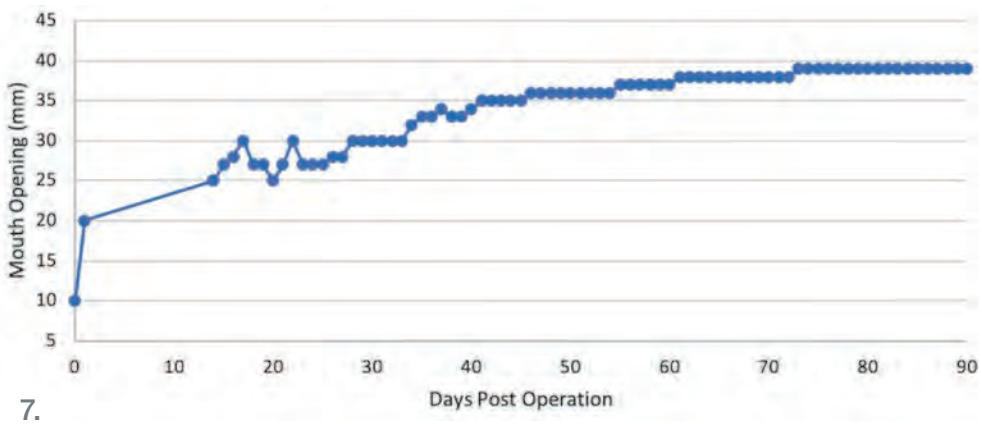


Figure 1. Clinical photograph pre-operatively 11 mm MIO.

Figure 2. Pre-operative dental panoramic radiograph with left condyle intracranial displacement.

Figure 3. Pre-operative computer tomography with left condyle intracranial displacement.

Figure 4. Pre-operative magnetic resonance imaging with left condyle intracranial displacement.

Figure 5. Intra-operative clinical photograph, demonstrating mandibular condyle gap arthroplasty with marking of the temporalis muscle flap.

Figure 6. Intra-operative clinical photograph of transposition of the temporalis muscle flap under the zygomatic arch.

Figure 7. MIO over 3 months post-operatively.

Figure 8. Clinical photograph post-operatively; 39 mm MIO.

reduction is associated with middle meningeal artery or intraparenchymal bleed, CSF leak secondary to dural tear, pneumocephalus and recurrent displacement (Arya and Chigurupati 2016; Kanno et al. 2016).

Open reduction is indicated when conservative measures are unsuccessful (44 reported cases of failed closed reduction), in patients with delayed diagnosis, mechanical ankylosis, comminuted glenoid fossa or condylar fractures, gross vertical instability, or when neurosurgical intervention is required (Arya and Chigurupati 2016; Díez-Suárez and Paredes-Farrera 2021). Conservative open surgical procedures include intraoral condylectomy and coronoidectomy approaches and fibreoptic assisted manipulation, which reduce the patient's morbidity, with greater precision than closed techniques (Arya and Chigurupati 2016; Liau et al. 2019). More invasive procedures are completed through intra/extra-cranial approach, with surgical access achieved via preauricular (40%), temporal (29%), preauricular with temporal extension (19%), retro or submandibular approaches (Arya and Chigurupati 2016; Díez-Suárez and Paredes-Farrera 2021). Craniotomy allows for open reduction, repair of dural tears and glenoid fossa reconstruction with bone graft, temporalis muscle flap, Fascia Lata, cartilage, titanium (plates or mesh), gel-foam, Duragen or Gore-Tex (Arya and Chigurupati 2016; Monteiro et al. 2019a). Glenoid fossa reconstruction prevents condylar relapse intracranially, and re-establishes vertical dimension and functional articulation (Arya and Chigurupati 2016; Kanno et al. 2016). In cases where condylar reduction is not achievable, arthroplasty can be performed by means of condylectomy, condylotomy or ankylotic bone removal either leaving the condylar head in situ or removing it (Monteiro et al. 2019b). In the absence of neurological signs and symptoms the condylar head can be left in situ, acting as the glenoid fossa, preventing its unpredictable removal, however there is a risk of continued osteogenesis (Zamorano et al. 2016). TMJ reconstruction can be achieved by alloplastic TMJ replacement or autologous grafts such as non-vascularised grafts from adipose tissue, the iliac crest, coronoid process or ribs. Alternatively vascularised pedicled or free flaps from the temporalis muscle, fibula, scapula, iliac crest, metatarsal phalangeal transfer or femoral medial epicondyle can also be used (Liau et al. 2019). The myofascial temporalis flap is robust, modifiable, pliable and thin pedicled flap that can be rotated and tunnelled under the zygomatic arch, for reconstruction of condylar defects following condylectomy or condylotomy, preventing infection and re-ankylosis, without significant masticatory functional morbidity (Kanno et al. 2016; Díez-Suárez and Paredes-Farrera 2021). However open reduction procedures increase complications such as facial nerve palsy, Frey's syndrome, formation of a parotid fistula and surgical scars (Chen et al. 2019).

Post-operatively IMF was performed in 71% of patients, with an average of 4-weeks of fixation, guiding occlusion and preventing further displacement (Díez-Suárez and Paredes-Farrera 2021). Physical therapy with mandibular opening exercises for 2-3 minutes, 3-5 times per day for 2-4 weeks post-operatively is critical to prevent ankylosis, improve function, speech and pain (Garcia-Guevara et al. 2013; Monteiro et al. 2019a). On review of 37 patients with MCID their average MIO was 37.4 mm with 41% of patients having mandibular midline deviation on function, pain, joint instability and malocclusion (Díez-Suárez and Paredes-Farrera 2021). Post operatively orthodontics, orthognathic or functional therapy may be required to manage malocclusion, facial asymmetry or reduced MIO (Menon and Sinha 2008).

Conclusion

MCID is rare with 72 cases reported in the literature (Díez-Suárez and Paredes-Farrera 2021). Diagnosis is based on clinical examination and radiological imaging. Management options for MCID includes surveillance, closed reduction or open reduction with or without craniotomy (He et al. 2015). The authors present the longest delayed diagnosis of MCID managed surgically with TMJ gap arthroplasty, reconstructed with a composite transpositional temporal myofascial flap, with bilateral coronoidectomies. At 3-month review the patients MIO was 39 mm, greatly improved from 11 mm pre-operatively, following TMJ physiotherapy using a TheraBite® Jaw Motion Rehabilitation System. This was maintained at a 12-month review.

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Compliance with Ethical Standards

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