What Dentists Should Know about the Temporomandibular Joint (TMJ)

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Learning Outcomes

1. The TMJ ‘Controversy’
2. TMJD Diagnosis
3. Conservative Management of TMJ Disorders
4. Arthroscopic Surgery of the TMJ
5. Open Joint Surgery and the Role of Eminoplasty
6. Condylar Fractures (Open Reduction and Fixation)
7. Alloplastic Total Joint Replacement (TJR)

TMJ Diagnosis

- Myofascial Pain Dysfunction, Mandibular Dysfunction, Facial Arthromyalgia
- Common Condition (Rugh 1985, Shiffman 1988, Wadha 2008)
  - 33% population have one symptom
  - 75% have one or more signs
  - Diagnos in 6 – 12% percent of adult population
- Female ♀ : Male ♂ up to 10:1
- Young > Old (different pathogenesis)
- Associated Diseases

Is it Confined to Western Societies?

- Abdel-Hakim AM. Stomatognathic dysfunction in the western desert of Egypt: an epidemiological survey. J Oral Rehabil. 1983 Nov;10(6):466-8: The most prevalent symptoms were headache (29%), pain in the ear (14%) and clicking joint sounds (19%); 84% of the subjects suffered from tenderness of one or more of the masticatory muscles, 8% of the subjects had painful movements of the mandible.
Heuristic Methodology

- A heuristic method is used to rapidly come to a solution that is reasonably close to the best possible answer, or "optimal solution".
- Heuristics are "rules of thumb", educated guesses, intuitive judgments……..or simply common sense.

"Treating Temporomandibular Joint Disorders Is Like Looking For A Good Restaurant In An Unfamiliar Town - It's Hard To Know Which Joint To Enter And Which One To Stay Out Of!!"


The Joints to Stay Out Of!

- Patient with a chronic headache/clicking TMJ, who has no signs of mandibular dysfunction
  (Greene CS: Hands in the Pocket Diagnosis!)
  - Can open mouth without pain
  - Can eat a regular diet
  - No history of direct trauma to the jaw coincident with the onset of the pain

The Joints to Treat

- Pain
- Click/ Crepitus
- Locking
- Restriction of opening (<40mm)
- Other joint pathology
- (Change in Occlusion/Bite)
- (Other causes of facial pain)

NOT HEADACHE.!!
The experience of the past 150 years in the diagnosis and management of chronic orofacial pain conditions has shown that a mechanistic, narrow approach is likely to produce iatrogenic harm, e.g., unnecessary root canal therapy, extractions, restorations, *TMJ surgery*, etc.

Wilkes (1987) Staging of TMJ ID

- **Stage I:**
  - Early clicking
  - Slight forward disc displacement with good anatomic contours
  - Anterior disc displacement with incipient bi-laminar zone elongation

- **Stage II:**
  - Episodes of pain, mid to late opening loud clicking with transient locking
  - Forward disc displacement with beginning deformity
  - Anterior displacement, bi-laminar elongation and early adhesions

Problem #1

Patients, physicians, many dentists and third party carriers are using the wrong terminology!

**Examples:**

- **TMJ Internal Derangement (ID)**

- **Anchored Disk Phenomenon**

- **Condylar Hyperplasia**
Wilkes (1987) Staging of TMJ ID

- **Stage III:**
  - Multiple episodes of pain, intermittent locking and restriction of motion and function
  - Anterior disc displacement with significant deformity
  - Advanced bi-laminar elongation with redundancy and prominent adhesions

- **Stage IV:**
  - Slight increase in symptoms over Stage III
  - Increase in severity over Stage III with early to moderate degenerative joint disease on tomograms
  - Increase over intermediate stage, hyalinization, rupture, cratering and bone exposure
**Wilkes (1987) Staging of TMJ ID**

- **Stage V:**
  - Crepitus, scraping and grinding, episodic or continuous pain and chronic restriction of motion.
  - Disc or attachment perforation with gross disc deformity and degenerative joint disease on tomograms.
  - prominent fibrillations, perforation, adhesions of the disc, with cratering and bone exposure.

**Problem #2**

There are multiple and confusing signs and symptoms

- **Signs**
  - Decreased Jaw ROM
  - TMJ noises, locking
  - TMJ tenderness
  - Masticatory muscle tenderness
  - Pain increases with jaw movement
  - Masticatory muscle hypertrophy
  - Excessive dental attrition

- **Symptoms**
  - TMJ noises
  - Jaw stiffness and fatigue
  - Facial and/or jaw pain
  - Locking
  - Dental sensitivity
  - Tinnitus
  - Earaches
  - Headaches

**Problem #3**

The dental profession embraced the concept that the TMJ is a unique articulation and therefore focused diagnostic and therapeutic modalities in the past on the occlusion and more recently on the intra-articular disc position.

**“Uniqueness” of the TMJ**


- Bilateral articulation with the cranium
- Occlusion and articulation of teeth affect joint movement and condylar positions
- Articular surfaces are fibrocartilage rather than hyaline cartilage
- TMJ contains an articular disc
Orthopedics

- Orthopedics is the branch of surgery concerned with acute, chronic, traumatic, and overuse injuries and other disorders of the musculoskeletal system.

- Orthopedic surgeons address most musculoskeletal ailments including arthritis, trauma and congenital deformities using both surgical and non-surgical means.

- Nicholas Andry coined the word "orthopaedics", derived from Greek words for "correct" or "straight" ("orthos") and "child" ("paidion"), in 1741, when at the age of 81 he published Orthopaedia: or the Art of Correcting and Preventing Deformities in Children.

Resulting In The Opinion...

"...treatment is necessary to prevent progression of internal derangement disorders from progressing to degenerative joint disease."


Alternatively

"...Temporomandibular joint disorders have been characterized as self-limiting, or non-progressive conditions."


Why the Controversy?

- Insufficient objective scientifically derived clinical evidence
- Failure to effectively communicate existing evidence to the profession
- Failure to use well-communicated scientific evidence
- Dependence on clinical trial and error
- Over-dependence on subjective reports of clinical success
- Low appreciation that clinical successes, though noteworthy, are not scientific proof of cause and effect.


If this is a chronic, progressive, non-self-limiting condition, one would expect that its incidence in the population would increase with age!

DATA

12% overall prevalence of TMD pain that peaked in women in the childbearing years fell to < 4% for women 65 years of age and older (even lower for men)

Problem #4

Sophisms
No science
Poor science
Opinion
Cults

Why Do Some Adhere to Concepts that Have Proven to be Scientifically Invalid?

- Early professional training and experience
- Reinforcement of familiar procedures
- Inertia
- Isolation
- Insecurity
- Unfamiliarity with the literature
- Inability to assess scientific evidence
- Blind belief in “schools of thought” sponsored by charismatic gurus
- Economics


Requirements of Scientific Clinical Research

- Clearly defined inclusion and exclusion diagnostic criteria
- Inter-examiner and intra-examiner reliability
- Clearly defined measures
- Sufficient number of subjects with repeated measures
- Random assignment of subjects
- Data collected by “blinded” examiners
- Replicability of data by other investigators
- Use of placebos
- Control groups to control for bias
- Appropriate sample size


Problem #5

Misdiagnosis leading to improper and/or inappropriate management

...Iatrogenic Disease

The experience of the past 150 years in the diagnosis and management of chronic orofacial pain conditions has shown that a mechanistic, narrow approach is likely to produce iatrogenic harm, e.g., unnecessary root canal therapy, extractions, restorations, TMJ surgery, etc.

TMJ Differential Diagnosis
Dental pain
Sinus “pain”
Neuralgias
Headaches
Migraines
Atypical facial pain syndromes
NB Pain and lump in parotid ✴️malignant

Diagnostic Dilemmas
Facial Pains
Dental pain
Sinus pain
Headaches
AFP

TMJ Pains
Myofascial pain
_internal derangement

Anchored Disc Phenomenon

TMJ Palpation
Tenderness
Click

Palpation for Click
Examination for Deviation

Palpation of Masseter
Tenderness
Spasm

Palpation of Temporals

Pre-Interventional Imaging
- Diagnostic Imaging
  1. OPG, Trans-cranial (Lateral Oblique), Trans-Pharyngeal, Reverse-Towne's
  2. ‘Bone Scan’
  3. Arthrography
  4. CT
  5. MRI (Dual Surface Coil)

Conservative TMJ Management
- Advice and Reassurance
- Bite Splints
- Physiotherapy
- Occlusal Modification
- Orthodontics
- Biofeedback
- Medications

Evidence Based Approach
- Problems
  - Tendency to "traditional" approach
  - Follow guidance of "trainer"
  - Do what you are used to doing
  - Do what you are able to do
- Solution
  - Use the evidence

Advice & Reassurance
- Placebo effect
  - "cures" 40% no matter what you do
- Empowerment of patient
  - controls internet mis-advice
- Supported in written format
  - improves retention of knowledge
Advice & Reassurance

- Common problem
  - 30% population will have click
- Benign condition
  - does NOT usually progress to arthrosis
- Usually treatable conservatively
  - <10% of secondary referrals → arthroscopy
  - 5% of secondary referrals → surgery

Bite Splints

- Various Varieties (suggests none works best)
  - Lower soft BRA
  - Stabilisation splint
  - Anterior repositioning appliance
  - Hard bite splint
- Ensure FULL occlusal coverage

Physiotherapy

- No strong evidence better than
  - other Occlusal appliances
  - Acupuncture
  - Relaxation
  - Jaw exercises
  - Biofeedback
- Weak evidence better than nothing
  - Reduced pain at rest
  - Reduced pain on function

Physiotherapy

- No good evidence for long term effect in ANY musculo-skeletal condition
  - Reversible and non-harmful
  - Some short-term benefit (?biofeedback)
- No evidence any better than doing nothing!
  - Irreversible
  - Contra-Indicated in TMJ
    - occasionally if denture wearers
    - effective stabilisation splint and recurrence after removal
Orthodontics

- Department of Orthodontics, College of Dentistry, University of Tennessee, Memphis 38163
- Court case 1988 orthodontist sued for “causing” TMJ problems
- Funding research by American orthodontists to investigate
- Whole issue devoted to outcome of this

Orthodontics

Summary of Findings
- Extraction of upper 4s and upper 2 to 2 retraction did not "distalise" condyles
- Correction of malocclusion does not necessarily improve TMJ symptoms
- TMJ symptoms may develop (and disappear) independently of orthodontics
- Tendency to improve TMJ symptoms
- Clicking does not usually progress to locking or arthrosis

Orthodontics

In Conjunction with Orthognathic Surgery
- 50% No Better
- 30% Better
- 20% Worse
- TMJ not an indication for orthognathic surgery

Orthodontics


- Retrospective analysis of 100 orthognathic surgery candidates with mandibular retrusion
- 58 unstable and 30 of 42 stable patients found to have ID of at least one TMJ
- Preoperative MRI of TMJ recommended prior to surgical correction of retrognathic deformities

Bio Feedback

Aim to Change Perception and Appraisal of Pain
- Emphasis on Self-management
- Education
- Stress Management
- Hypnosis
- Psychoanalysis

Bio Feedback

- Useful and effective for chronic pain
- Scientifically validated
- Psychoanalytical Methodology
- Related To Psychological Disturbance (Anxiety, Stress And Depression)

Successful for long term management of chronic TMJ pain
Medical Therapy

- Simple analgesics
- NSAIDs
- Opioids
- Benzodiazepines
- Anti-depressants
- Local analgesics
- Botulinum toxin
- Steroids

Paracetamol
- effective for simple pain relief
- not effective for treatment

Medical Therapy

- Simple analgesics
- NSAIDs
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- Diazepam
  - 2-5mg at night, possibly tds
  - reduce muscle spasm acutely
  - anxiolytic
  - no long term efficacy
  - use as short course (2 weeks max)
  - risk of dependency
  - risk of misuse (black market)

Medical Therapy

- Simple analgesics
- NSAIDs
- Opioids
- Benzodiazepines
- Anti-depressants
- Local analgesics
- Botulinum toxin
- Steroids

Triecylcicls or SSRI
- low dose are anxiolytic and muscle relaxant
- side effects GI upset (both), dry mouth and sedation (TCA)
- positive benefit for chronic non-malignant pain
Medical Therapy

- Simple analgesics
- NSAIDs
- Opioids
- Benzodiazepines
- Anti-depressants
- Local analgesics
- Botulinum toxin
- Steroids

- no RCT but fair evidence of benefit in myofascial pain
- 25mg TCA rising with therapeutic effect (wait 3/52)
- 10-20mg SSRI (no evidence for TMJ pain)
- regular review under care of hospital/GP
- Maintenance dose for 6/12 once pain free
- Slow withdrawal (risk of s/e)

- useful for diagnostic purposes
- LA to TMJ may help anchored disc (arthrocentesis)
- LA to trigger points in muscle may help break cycle
- no evidence for long term benefit

- (UNLICENCED)
- Cures the wrinkles therefore makes them better!!!!
- paralysis of muscle by blocking acetylcholine
- weakens large muscles (masseter)
- trigger point injection for myofascial pain
- early evidence but long term benefit not studied
- 50 units Dysport to masseter/temporalis in up to 3 points

- injection into joint
- beneficial for OA generally (good evidence)
- use with caution
- articular erosion after more than 2 injections
- post-arthroscopy capsulitis

- pre-arthroscopy treatment
- indications
- technique
- findings
- post-operative care
- complications
- outcomes
**Pre-Arthroscopy Treatment**

- **Visit 1**
  - Advise, reassure
  - Soft diet, avoid wide opening
  - Topical NSAIDs, soft BRA
  - 8 weeks active treatment

- **Visit 2**
  - Persist with BRA, NSAIDs
  - Discuss and list arthroscopy
  - Consider muscle relaxant
  - 8 weeks

**Indications**

- **IN AN IDEAL WORLD**
  - Pre-operative physiotherapy is part of conservative regime
  - MRI scan

- **Failed conservative therapy with**
  - Restricted opening
  - Persistent pain
  - Locking

**Technique**

- **General Anaesthesia**
  - (antibiotic prophylaxis)
  - nasal intubation
- EUA
- MUA
- Arthroscopy
- Arthrocentesis

*Anterior Open Bite Patients Should Bypass Arthroscopy*
Arthroscopic TMJ Surgery

- Rigid fibre-optic technology to visualize the superior & inferior spaces of the temporo-mandibular joint (TMJ) in a clinic and operating theatre settings under LA + intravenous sedation or GA

- Since it comes in a 1.2mm (18 gauge needle) Scope System it is designed to provide minimally invasive diagnostic and operative procedures with a second channel insertion

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Arthrocentesis

- normal saline with 1000 units heparin
- 200 ml
- 150mmHg pressure

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Post-Operative Care

- Check airway
- Gentle active mobilisation
- Passive mobilisation after few days
- Heat to joint
- Physiotherapy to assist in above
  - Mobilisation
  - Ultrasound

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Complications

1. Uncommon
2. Swelling
3. Weakness of temporal CN VII
4. Sensory loss auriculo-temporal
5. Disturbance of hearing
6. Intra-cranial perforation
Outcome

International Series

- Anchored Disc Phenomenon 95% cure
- ADD Without Reduction 70% cure

Conclusion

- Following Failed Conservative Treatment
- Diagnostic
- Therapeutic

What to Refer

- Pain
- Restriction Of Opening (<35mm)
- Locking
- Associated Rheumatological Disease
- Recurrent Dislocation
- Facial Deformity

Open TMJ Surgery

Not Just a Click

The Normal TMJ

- Synovial joint with pathology and dysfunction similar to other joints
- Paired joint with its final position determined by the teeth and not ligaments
- Not a non-weight bearing joint
- Ginglymoarthrodial articulation
- Complex tri-axial range of movements
- Biting results in a TMJ joint reaction force
- Pressure in the joint space is slightly negative at rest, up to +200mmHg on clenching and -130mmHg on opening
- Intra-articular pressure varies between individuals, is greater in females and is decreased by bite splints

TMJ Anatomy

- Rests in the glenoid fossa
- Collagenous articular disc (intracapsular meniscus)
- Zones of the meniscus (Rees et al, 1954)
  - Anterior band – attached to fossa & condyle
  - Posterior band – attached to SH Lat. Pterygoid
  - Intermediate band
- Innervated by the masseteric & auriculo-temporal branches of V3
Parasagittal section of the TMJ

1. Facial Nerve Trunk
2. Auriculo-Temporal Nerve
3. External Auditory Meatus
4. Temporal Branch of the Facial Nerve

Pre-Surgery
- Diagnostic Imaging
  1. OPG, Trans-cranial (Lateral Oblique), Trans-Pharyngeal, Reverse-Towne's
  2. Bone Scan
  3. Arthrography
  4. CT
  5. MRI (Dual Surface Coil)

Indication for TMJ Surgery
1. Internal Derangements
2. TMJ Hypermobility (Recurrent Dislocation)
3. Ankylosis
4. Advanced Degenerative Joint Disease
5. Condylar Fractures
6. Benign/Malignant Lesions of the TMJ or Condyle

Surgical Approaches to the TMJ
1. Pre-auricular
2. Endaural
3. Post-auricular
4. Rhytidectomal
5. Submandibular (Retro-mandibular)
6. Intraoral
7. Through Existing Lacerations

Endaural (Pre-auricular) Approach
Internal Derangement of the TMJ

- Also known as TMJ Disk Interference Disorder
- Most common TMJ Arthropathy

Aetiology:
- Controversial
- Trauma plays a major role.
- Acute macro trauma - Fall, or blow to the face
- Chronic micro trauma - Parafunctional activities (nocturnal clenching and/or bruxism)
Surgery for: Internal Derangements

1. Surgery **without** Disk Repositioning
   a. Arthrocentesis
   b. Arthroscopic lysis and lavage
   c. Arthroplastic release of adhesion with temporary silastic implant
   d. Eminectomy
   e. Diskoplasty (recontouring)
   f. Modified condylotomy

2. Surgery **with** Disk Repositioning
   a. Arthroscopic disk repositioning
   b. Disk Plication
   c. Diskopexy
   d. Diskectomy without replacement
   e. Diskectomy with replacement (dermis, cartilage, fascia, temporalis, etc.)
   f. Eminectomy

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Eminectomy with Disk Plication

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Diskectomy without Replacement
Diskectomy with Replacement

Condylar Hypermobility
- Acute, Chronic (Habitual), Long Standing
- A triad are recognised in the genesis of TMJ subluxation:
  - Ligamentous and capsular flaccidity
  - Emmental deformation
  - Trauma
- Aetiology:
  - Post-traumatic
  - Spontaneous
  - Associated with psychiatric illness
  - Drug therapy
Condylar Hypermobility

Precipitating Factors:
- Yawning
- Vomiting
- Laughing
- Extremes of Masticatory Effort (taking a bite from a big sandwich)

Surgery for: TMJ Hypermobility

- Lateral pterygoid myotomy
- Restrictive techniques:
  - Le Clerc – eminence down fracture
  - Dautrey – eminence lengthening
- Obstruction removal techniques:
  - Eminectomy

Eminence Down Fracture

Zygoma Arch Down Fracture
Eminectomy

TMJ Ankylosis

- Rowe defined pseudo, true and false ankylosis
- Osseous, fibrous, fibro-osseous or cartilaginous fusion of the bone joint and articular surfaces
- Four types are described:
  - Type I – flattened condyle and limited space
  - Type II – bony fusion at outer margins
  - Type III – bony fusion between ramus and zygomatic arch
  - Type IV – entire joint replacement

Aetiology of TMJ Ankylosis

- Trauma
  - Sub-condylar fractures
  - Intra-capsular fractures
- Still’s Disease (juvenile chronic arthritis)
- Rheumatoid Arthritis
- Joint Infection
- Tumours (villo-nodular synovitis)

Surgery for: TMJ Ankylosis

- Bony Ankylosis:
  - Arthroplasty with autogenous graft
  - Condylectomy with autogenous or alloplastic graft
- Fibrous Ankylosis:
  - Arthroplasty with meniscal salvage
  - Arthroplasty with meniscectomy (with or without autogenous or alloplastic grafting)
Arthroplasty with Alloplastic Graft

Alloplastic Condylar Prostheses
1. Kent-Vitek
2. Synthes
3. Derlin-Timesh
4. Christensen I
5. Christensen II
6. Biomet-Lorenz

Condylectomy with Alloplastic Graft
Condylectomy with Autogenous Graft

Common Degenerative Conditions
- Osteoarthritis
  - Increasing incidence after 50 years
  - Pain, crepitus, limitation of movement
  - Preceded by TMD or Internal Derangement
  - Degenerative changes, denudation, & eburnation of condyle
- Rheumatoid Arthritis
  - Common in patents with generalised RA
  - Stiffness, limitation of movement
  - Erosion of condyle by vascular pannus

Surgery for: Degenerative Disease
- Arthroplasty with diskectomy – replacement (dermis, cartilage, fascia, temporalis, etc.)
- High condylar shave (partial condylectomy)
- Joint replacement:
  - Alloplastic
  - Autogenous (costochondral, SCM, ileum, clavaria, etc.)
Joint Replacement

Unusual Diseases of the TMJ

1. Benign Lesions
   1. Chondroma
   2. Synovial Cyst (Ganglion Cyst)
   3. Osteochondromatosis
   4. Suppurative Arthritis
   5. Benign Chondroblastoma (Codman’s Tumour)
   6. Aneurysmal Bone Cyst
   7. Chondrocalcinosis
   8. Synovial Fistula
   9. Aseptic Necrosis

2. Malignant Tumours
   1. Osteogenic Sarcoma
   2. Chondrosarcoma
   3. Synovial Cell Sarcoma
   4. Multiple Myeloma
   5. Lymphoma
   6. Aggressive Fibromatosis

Foreign Body (Giant Cell) Response
Case Presentation...

- 32-year-old Bahraini male, Royal National Guards
- No relevant medical history, and on no medications with no known allergies
- Presented with: severe pain from ‘jaw’, malocclusion and step deformity, multiple avulsed teeth following a ‘fall’ from his jet ski

Case Presentation...

- Trismus (<25mm)
- Swelling & ecchymosis
- Sublingual haematoma
- Abnormal bony crepitus, and mobility on functioning
- Visible and palpable deformity of the lower border of the mandible
- Paresthesia /Anesthesia of the lower left lip and chin (cranial nerve V₃)
- No obvious facial nerve (VII) weakness

Aggressive Fibromatosis

Condylar Fractures

Transmasseteric Antero-Parotid Approach
Radiographic Studies – ‘Mandibular Series’

- Posterior-anterior mandibular views (PA)
- Orthopantamogram (OPG) – if an OPG is unavailable, lateral oblique mandibular views
- For more definitive imaging, a computerized tomographic (CT) scan with axial cuts ranging from 5 mm to 1.5 mm
- An open-mouth reverse Towne’s view is included in these series if there is a condylar fractures

Case Presentation...

- Displaced, Compounded, Comminuted fracture of the anterior (symphysis) segment of the mandible extending through the left body and into the left body and ramus, Complicated with the left inferior-dental nerve and with teeth
- Displaced, Compounded fracture of the right body Complicated with the left inferior-dental nerve and with teeth
- Displaced, Compounded fracture of the right condylar neck (extra-capsular)
Transmasseteric antero-parotid approach for open reduction and internal fixation of condylar fractures

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SUMMARY: Introduction. Treatment of fractures of the mandibular condylar fractures varies among centres as there is still no general consensus. The aim of this paper was to determine the safety and efficacy of surgical treatment using a transmasseteric approach for direct plating. Patients and methods. A prospective clinical study was conducted using a transmasseteric approach for direct plating. Complete medical records were compiled for all patients who had a fracture, except for those who were fracture dislocations. The fractures were treated surgically with a transmasseteric or pericondylar approach using miniplates and screws for fixation. Patients were carefully followed up and were asked to answer a survey paper 2–3 months postoperatively. Results. Occlusion practically identical to the preoperative condition was achieved in 51 out of 53 fracture patients (96%). Postoperative interincisal distance was 30–40 mm (mean 34 mm). 4 patients (12%) had postoperative deviation due to side of injury during mouth opening. Facial symmetry was achieved in all of the patients. Eight out of 36 cases (22%) had transient weakness of certain (limited) facial muscle groups, lasting for 2–8 weeks. In one of these patients, a mild weakness of the upper lip and lower oral part of the jaw persisted for 15 months. There were 2 cases of antral fractures (6%), all of them in female patients. The fracture healed uneventfully, and no further complications were observed. Conclusion. The transmasseteric approach offers a safe and effective approach for direct fixation of condylar fractures. Keywords: Maxillofacial injuries; Condylar fractures
Aims of Treatment

- The primary goals of mandibular fracture treatment are to restore:
  - continuity of the mandible
  - restore a patient’s habitual functioning occlusion
  - maintain or re-establish acceptable facial and dental aesthetics
  - minimize neurosensory or facial nerve (CN VII) impairment.
  - maintain adequate nutritional status
  - minimize patient discomfort and inconvenience.

Timing of Treatment

- Not clearly defined
- The longer an open or a compound fracture is left untreated, the incidence of complications increases – Most are based on orthopedic literature (Linuka et al 1991)
- Reduction should be immediate unless – patient has other more serious or life-threatening injuries

Long-term Complications of Mandibular Fracture Repair

- The development of infection, nonunion, and related complications after the repair of mandibular fractures correlates with a history of tobacco and alcohol use and ORIF of multiple fractures
- There were no statistically significant relationships to patient demographics (age, sex, location), etiology of fracture, fracture site, lag time to repair, length of hospitalization, or the use of antibiotics
- Antibiotic therapy appears to have had NO impact on the development of postoperative complications

Post-op Antibiotic Prophylaxis in Mandibular Fractures

- The use of post-operative oral antibiotics in uncomplicated fractures of the mandible had no benefit in reducing the incidence of infections (Abubaker et al 2001 – 1b SoE Level)
- No statistically significant benefit to the administration of post-operative antibiotics in patients undergoing ORIF of mandibular fractures (Miles et al 2006 – 1b SoE Level)
- A 1-shot or 1-day administration of prophylactic antibiotics showed best results in reducing infections in mandibular fractures (Andreasen et al 2006 – 1a SoE Level)

...In Conclusion

- PA mandible and an OPG are the gold standard (CT scan justifiable in special cases only)
- Open reduction & stable internal fixation of the fractured mandible is associated with low complications
- 1-shot or 1-day administration of prophylactic antibiotics is recommended
- If conducted properly, the transparotid approach offers a safe and effective approach for direct fixation of condylar fractures
**Introduction**

- Internal derangement (ID) is the most common arthropathy of the temporomandibular joint (TMJ)
- Surgical intervention in ID:
  - presence of pain
  - structural alteration that is amenable to surgical correction
  - dysfunction that impairs ability to carry out normal function
  - failed to improve with non-surgical therapy
- Incidence of surgical treatment for ID of the TMJ range from 1% to 25%. Most authors report 5% of require it

**Surgery for Internal Derangement**

**Surgery without Disk Repositioning**

a. Arthrocentesis
b. Arthroscopic lysis & lavage
c. Arthroplastic release of adhesion with temporary silastic implant
d. Eminectomy
e. Diskoplasty (recontouring)
f. Modified condylotomy

**Surgery with Disk Repositioning**

a. Arthroscopic disk repositioning
b. Disk Plication
c. Diskectomy without replacement
d. Diskectomy with replacement (dermis, cartilage, fascia, temporalis, etc.)
e. Eminectomy

**Rationale for Eminectomy**

- Originally described for habitual dislocation of the TMJ (Myrhaug et al., 1991)
- Suggested for recurrent ‘Closed Lock’ (Nitzan & Dolwick, 1991)
- Used for Internal Derangement of the TMJ (Weinberg et al., 1984)
- Was modified to remove the physical barrier to the articular disk – effectively decompressing the intercapsular space (Stassen et al., 1991)

**Rationale for Eminectomy**

- Reported to be effective in correcting mechanical instability in Internal Derangement (Kestens et al., 1984)
- Increases joint space (Williamson et al., 2000):
  - decompressing the irritated disc
  - allowing it to assume a more favourable disc – eminence – condyle relation,
  - without damaging the unique structure of the condylar head

**Anatomy Recap**

- Rests in the glenoid fossa, with considerable variations in dimensions
- Collagenous articular disc (intracapsular meniscus)
- Zones of the meniscus (Boas et al., 1994)
  - Posterior band – attached to fossa & condyle
  - Anterior band – attached to superior head of Lt. Pterygoid
  - Intermediate band
  - Innervated by the masseteric & auriculo-temporal branches of V₃
Rationale for Eminectomy

- Shallow Fossa (low angle) – action of temporalis and masseter in mouth closing results in a postero-superior force on the anterior part of the posterior band
- Deep Fossa (steep angle) – effect of the forces are directed more posteriorly to the posterior band (bilaminar zone) causing anterior displacement of the disc and Internal Derangement
- Therefore reducing this 'steep angle' decompresses the inter-capsular compartment by creating a larger anterior recess in the superior joint space

Patients and Methods

- 26 patients with advanced stage ID of the TMJ
- All treated with 'true' eminectomy after 1 year of failed non-invasive conservative treatment
- Symptoms: chronic severe pain, moderate to severe limitation of mandibular movement, bothersome joint noises
- Supported by MRI evidence of late stage disc displacement - all subjects in this study were diagnosed with disc displacement with and without reduction and with and without limited mouth opening
- Of the 26 patients – 44 joints had surgery, with 18 bilateral cases (3 left & 5 right). There were 11♂ and 15♀ with an age range of 20 - 52 (mean 35 years)
- All patients had a complete dentition

Clinical Evaluation

- Subjective Evaluation:
  - Mandibular Functional Impairment Questionnaire (MFIQ)
- Objective Evaluation:
  - Maximal Mouth Opening - Inter- Incisal Distance (IID)
  - MRI Staging of Internal Derangement of the TMJ

Mandibular Function Impairment Questionnaire (MFIQ)

- The MFIQ was developed by Stegenga et al. in 1993
- A 17-item questionnaire divided into – masticatory activities and non-masticatory activities
- Each item is in the form of a 5-point Likert scale
- Patients indicate to what extent they had difficulties in doing that task (0 = no difficulty, to 4 = extreme difficulty / impossible without assistance)
- The MFIQ questionnaire reliably assesses the degree of impairment of specific jaw functions without measuring symptoms and signs causing the functional impairment

Inter- Incisal Distance (IID)

- Maximal, unassisted clinical mouth opening between incisor teeth before and after eminectomy was recorded
- Without overbite compensation
Staging of internal derangement of the TMJ

- Clinical signs & symptoms and MRI were used to classify the internal disc derangement, with emphasis on clinical findings.
- MRI was considered as a golden standard to evaluate the disc position (Gibbs et al, 1998).
- Clinically, the internal derangement was based on Wilke’s (1987) staging.
- Patients were pre-assessed by a psychiatrist to rule out psychological distress, specifically depression, anxiety, and the presence of non-specific physical symptoms reflecting somatization tendencies.

Results

- All Patients were followed up for at least 1 year.
- MFIQ – out of 26 patients.
  - In 5%, the score reduced from a preoperative 3 (out of 4) to 0.
  - In 19%, the score reduced from a preoperative 3 to 1.
  - In the remaining 2%, it improved to 2.
- IID:
  - In 90% of patients had an increased maximum mouth opening one year postoperatively (range 10-20 mm, mean 15 mm).
  - A statistically significant result using a paired t test (p < 0.001).
  - The maximal unassisted clinical mouth opening between the incisor teeth before and after operation was significantly greater in all but two patients.
- MRI:
  - MRI showed increase in rotation and translatory movement of the condylar head.
  - Findings consistent in all cases where the MRI was adequately clear for analysis.

Discussion

- IID:
  - A statistically significant result using a paired t test (p < 0.001).
- MFIQ:
  - This subjective assessment is a simple tool for assessment of improvement of TMJ function.
  - The results confirmed a significant reduction of impairment of TMJ functions.
  - MR imaging was used to confirm internal disc derangement, which was reduced in all cases after true eminectomy.
  - The patients were not only happy with their restored function, but also the lack of any obvious postoperative scar.

Conclusion

‘True’ eminectomy may be used to effectively treat advanced stages of internal derangement in cases which have failed to respond to non-invasive conventional treatment.

Alloplastic Joint Replacement

Total Joint Replacement (TJR) in the Temporomandibular Joint (TMJ)

FACT.!!

The practice of modern orthopaedic surgery would be unthinkable without the availability of alloplastic replacement devices.
Alloplastic Joint Replacement

A Biomechanical Answer Rather Than a Biological Solution To The Management of Severe and Debilitating Anatomical TMJ Disease

These are Salvage, End-stage Devices for the Surgically and/or Pathologically Mutilated Joint

Goals of TMJ Replacement

1. Improve Function and Form
2. Reduce Suffering
3. Contain Excessive Treatment
4. Contain Further Cost
5. Prevent Further Morbidity

Indications for total replacement of the TMJ

• Prerequisite: Failed conservative management (including arthroscopy if possible).
• Diagnosis: Computed tomogram or magnetic resonance scan as a minimum (not just plain radiographs).

Indications for total replacement of the TMJ

• Diseases involving condylar bone loss:
  1. Degenerative joint disease (osteoarthritis) not responsive to other modalities of treatment
  2. Inflammatory joint disease (e.g., rheumatoid, ankylosing spondylitis, psoriatic) not responsive to other modalities of treatment
  3. Ankylosis not responsive to other modalities of treatment
  4. Post-traumatic condylar bone damage
  5. Postoperative condylar loss (including neoplastic ablation)
  6. Previous prosthetic reconstruction (failed alloplastic graft)
  7. Previous costochondral graft (failed tissue graft)
  8. Serious congenital deformity
  9. Multiple previous procedures

Indications for total replacement of the TMJ

• Clinical Indications (a combination of the following):
  1. Dietary score of <5/10 (liquid scores 0, full diet scores 10)
  2. Restricted mouth opening (<35 mm)
  3. Occlusal collapse (anterior open bite or retrusion)
  4. Excessive condylar resorption and loss of height of vertical ramus
  5. Pain score >5 out of 10 on VAS (combined with any of the others)
  6. Other quality of life issues

Contraindications

1. Age?
2. Uncontrolled para-functional habits?
3. Local infective process
4. Severe immunocompromise
5. Severe coexistent diseases (American Society of Anesthesiologists Grade III)
6. Psychosis

### Indications for the Use of Various Modalities for TMJ Reconstruction

<table>
<thead>
<tr>
<th>Condition</th>
<th>Autogenous</th>
<th>Alloplast</th>
<th>Engineered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammatory Arthritis</td>
<td>+*</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Ankylosis</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Failed Autogenous Graft</td>
<td>+</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Loss of Vertical Height</td>
<td>+±</td>
<td>++</td>
<td>++*</td>
</tr>
</tbody>
</table>

*JRA, juvenile rheumatoid arthritis.
†Future potential after further in vitro and in vivo studies.
‡Future potential after further in vitro and in vivo studies.


#### The Impact of Total Joint Replacement In Rheumatoid Arthritis

Device objective performance and patient subjective and objective evaluations provided evidence that the pre-operative status of the joint determines the extent of post-operative functional gain.

Therefore, postponing TJR for too long will result in less functional benefit.


#### Inflammatory Arthritis of the TMJ is not Responsive to other Modalities of Treatment

#### Inflammatory Arthritis of the TMJ is not Responsive to other Modalities of Treatment

#### Autogenous vs. Alloplastic TMJ Reconstruction in Rheumatoid-Induced TMJ Disease

**Conclusion:**
- Alloplastic prostheses provided statistically significant better subjective and objective results than did autogenous tissue for the reconstruction of the TMJs of patients with rheumatoid arthritis.

**Further:**
- Alloplastic prosthetic reconstruction eliminates donor site morbidity, reduces OR time, and permits mandibular advancement to be simultaneously performed with excellent long term stability.


#### Recurrent Fibrous and/or Bony Ankylosis not Responsive to other Modalities of Treatment

**Targeted Assessment of the TMJ in Patients with Rheumatoid Arthritis**

Study:
- 61 RA patients recorded signs and symptoms of TMJ pain and dysfunction.

**Results:**
- 70.5% reported at least 1 symptom; 59% had at least 1 sign.

**Conclusion:**
- A significant percentage of RA patients have signs and symptoms of TMJ involvement and measurement of mandibular range of motion proved to be an important measurement tool.

Recurrent Fibrous and/or Bony Ankylosis not Responsive to other Modalities of Treatment

Autogenous Fat Graft

- Total alloplastic replacement with a patient fitted prosthesis appears to provide a safe and effective management for patients with re-ankylosis of the TMJ.
- Autogenous fat transplantation appears to be a useful adjunct as its use appears to minimize the re-occurrence of joint heterotopic calcification, consequently providing improved and consistent range of mandibular motion over time.


A Retrospective Study of the Costochondral Graft in TMJ Reconstruction

- 57 patients - 76 costochondral grafts
- 2 years follow-up
- In patients with failed alloplastic discs and/or total joints, the results were less predictable.
- A preoperative diagnosis of ankylosis was associated with a high complication and surgery rate suggesting caution in this group of patients.


Reconstruction of the Temporomandibular Joint Autogenous Compared with Alloplastic

- 49 patients - costochondral grafts
- 30 patients - alloplastic total joints
- 2 years follow-up
- Patients in both groups showed an improvement, but more patients required re-operation in the autogenous group.

Follow up of Mandibular Costochondral Grafts After Release of Ankylosis of the TMJ

55 patients - 25 unilateral/30 bilateral
7 – 10 years follow up
• 59% good remodeling; 25% resorbed; 9% re-ankylosed; 4% overgrowth
• 58% satisfactory MIO
• 18% unsatisfactory MIO
• 24% failure


Failed Alloplastic TMJ Reconstruction

Proplast-Teflon
Silastic

Treatment Outcomes for TMJ Reconstruction after Proplast-Teflon Implant Failure

Conclusion
• Alloplastic devices provide better functional and occlusal results than do autogenous tissues in patients requiring total TMJ reconstruction after failed Proplast-Teflon implants.


Conclusion
A Total Alloplastic TMJ reconstruction device, appropriately designed and tested, manufactured with biologically compatible materials, and implanted properly is a safe and effective management modality in indicated cases.

TMJ Prosthesis Devices

<table>
<thead>
<tr>
<th>Type of joint</th>
<th>Titanium-ALMOPC surface</th>
<th>LAMPOC</th>
<th>Stent prosthesis (short stem)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condylar</td>
<td>Co-Cr-Mo alloy</td>
<td>Co-Cr-Mo alloy</td>
<td>Co-Cr-Mo alloy</td>
</tr>
<tr>
<td>Ramus</td>
<td>Co-Cr-Mo alloy</td>
<td>Co-Cr-Mo alloy</td>
<td>Co-Cr-Mo alloy</td>
</tr>
<tr>
<td>Type of joint</td>
<td>Condyle/titanium (7 mm)</td>
<td>Crown (6 mm)</td>
<td>Crown (6mm)</td>
</tr>
<tr>
<td>Costs</td>
<td>£17,879 for the custom-made version</td>
<td>£17,879 for the custom-made version</td>
<td>£17,879 for the custom-made version</td>
</tr>
</tbody>
</table>

Costs £17,879 for the standard stock version, and £17,879 for the custom-made version.
What’s the Evidence it Works?

Clinical studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Follow-up</th>
<th>Main findings</th>
<th>Implant type</th>
<th>Success rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morris et al. (2011)</td>
<td>50</td>
<td>24 months</td>
<td>Significant improvements</td>
<td>TDM Concepts</td>
<td>95%</td>
</tr>
<tr>
<td>Morris et al. (2012)</td>
<td>40</td>
<td>12 months</td>
<td>Significant improvements</td>
<td>TDM Concepts</td>
<td>90%</td>
</tr>
<tr>
<td>Morris et al. (2013)</td>
<td>60</td>
<td>36 months</td>
<td>Significant improvements</td>
<td>TDM Concepts</td>
<td>88%</td>
</tr>
<tr>
<td>Morris et al. (2014)</td>
<td>30</td>
<td>24 months</td>
<td>Significant improvements</td>
<td>TDM Concepts</td>
<td>92%</td>
</tr>
</tbody>
</table>

Many patients experienced significant improvements in pain and function after TDM Concepts therapy.

References:
- Morris et al. (2011)
- Morris et al. (2012)
- Morris et al. (2013)
- Morris et al. (2014)
**Biomet Microfixation**
Patient Matched TMJ Implants

- Current Process
- Capabilities

**Process**

- Typically takes 2 months from request to surgery
- Can be reduced to 3 weeks w/ excellent communication

**Basic Design**

- Cobalt-chromium mandibular component w/ titanium plasma spray (entirely titanium for patient w/ nickel allergy or large resection)
- Ultra-high molecular weight polyethylene (UHMWPE) Fossa component
- Same materials and articulating surfaces as stock TMJ implants

Web-based conference call vs. Physical model Design Approval
### Temporomandibular Joint Total Replacement Prostheses: Current Knowledge and Considerations for the Future

1. TMJ TJR have shown promising outcomes. Reported improvements are good for both subjective and objective parameters, worthy of further evaluation.

2. Future larger sample size studies are needed to confirm the current data and demonstrate the superiority of TMJ TJR over less invasive modalities.

3. Better integration of clinical and research settings for better understanding of indications, possibly increasing them


<table>
<thead>
<tr>
<th>Adverse outcome</th>
<th>Number</th>
<th>Percentage (out of 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative difficulty</td>
<td>32</td>
<td>0.77</td>
</tr>
<tr>
<td>Malocclusion/misplacement</td>
<td>18</td>
<td>0.46</td>
</tr>
<tr>
<td>Pain, swelling, or infection</td>
<td>14</td>
<td>0.33</td>
</tr>
<tr>
<td>Postoperative complications</td>
<td>10</td>
<td>0.22</td>
</tr>
<tr>
<td>Osteonecrosis</td>
<td>10</td>
<td>0.22</td>
</tr>
<tr>
<td>Fracture</td>
<td>7</td>
<td>0.17</td>
</tr>
<tr>
<td>Prosthetic complication</td>
<td>7</td>
<td>0.17</td>
</tr>
<tr>
<td>Infection</td>
<td>5</td>
<td>0.11</td>
</tr>
<tr>
<td>Delamination</td>
<td>6</td>
<td>0.14</td>
</tr>
<tr>
<td>Dislocation or perforation</td>
<td>4</td>
<td>0.09</td>
</tr>
<tr>
<td>Loosening of component</td>
<td>2</td>
<td>0.04</td>
</tr>
<tr>
<td>Malocclusion</td>
<td>1</td>
<td>0.02</td>
</tr>
<tr>
<td>Total</td>
<td>178</td>
<td>3.87</td>
</tr>
</tbody>
</table>

# Adverse Outcomes

Adverse outcomes 1999-2006. (Table from Professor LG Maskell and TMJ Concepts, and reproduced with permission. Presented at the New York University College of Dentistry, 25 August, 2007.)

Adverse outcome | Number | Percentage (out of 2000) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative difficulty</td>
<td>32</td>
<td>1.60</td>
</tr>
<tr>
<td>Postoperative complications</td>
<td>10</td>
<td>0.50</td>
</tr>
<tr>
<td>Osteonecrosis</td>
<td>10</td>
<td>0.50</td>
</tr>
<tr>
<td>Fracture</td>
<td>7</td>
<td>0.35</td>
</tr>
<tr>
<td>Infection</td>
<td>5</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Thank You