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British Association of Oral and Maxillofacial Surgeons

BAOMS Student Bursary

Medication related osteonecrosis of the jaws (MRONJ); Review of care at Royal Albert and Edward Infirmary (RAEI)

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Contents

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The initial aim of this project was to determine how patients presenting with an increased risk of medication related osteonecrosis of the jaw (MRONJ) were being managed, the effect of postoperative antibiotics and factors limiting recovery. The project was based on a standard, devised by Tim Malins on behalf of NHS England and Dental Local Practioners Network for Shropshire and Staffordshire (Malins 2015) taking into account the recommendations of the American association of oral and maxillofacial surgeons position paper on medication-related osteonecrosis of the jaw -2014 update, (American Association of Oral and Maxillofacial Surgeons 2014):

1. 100% of patients taking anti-resorptive medications should be given a supply of 0.2% chlorhexidine mouth wash 10ml four time per day for a minimal of 14 days following treatment.

2. 100% of patients having a surgical procedure should receive Metronidazole 200mg TDS for 5 days or co-amoxiclav 250/125mg TDS for 5 days.

3. 100% of patients taking anti-resorptive medications should have a clinical follow up within 6 weeks.

The guidelines were changed following the publication of (Scottish Dental Clinical Effectiveness Programme 2017) in March 2017, discouraging the use of any antibiotics.

Therefore the data analysis was changed to look at care provided for patients treated at Royal Albert and Edward Infirmary (RAEI) who went on to develop MRONJ. Several conclusions could be drawn from the results:

- Care at RAEI for MRONJ patients was very variable
- Further education is needed for patients and healthcare prescribers prior to the use of these drugs
- Local, patient-centered protocols should be developed at RAEI for management of MRONJ

Introduction

Modern medicine is creating a changing landscape of the pharmacological drugs that are used in the treatment of osteoporosis, rheumatological conditions and oncology. Many of these agents are impacting on the treatment and healing of dento-alveolar surgery as well as spontaneous necrosis of maxillary and mandibular bone; resulting in medication related osteonecrosis of the jaw (MRONJ).

Background

Medication related osteonecrosis of the jaw (MRONJ) is an all-encompassing term that has superseded the term bisphosphonate related osteonecrosis of the jaw (BRONJ). BRONJ was first reported and published in 2003, subsequent cases of spontaneous and post extraction osteonecrosis however have been seen more recently in patients taking a number of other medications. These medications include monoclonal antibodies and tyrosine kinase inhibitors as well as anti-resorptive agents licenced for use in osteoporotic patients as well as in bone-related malignancy. As well as anti-angiogenic, biological drugs such as bevacizumab and sunitinib have been licenced for use in renal cell carcinomas, neuroendocrine tumours, gastro-intestinal tumours (Tanna et al. 2017).

Since 2015, the European Medicines Agency advised prescribers to issue patient reminder cards detailing the risk of BRONJ in relation to their bisphosphonate medication to help educate patients of the risks and benefits of the medications. (European Medicines Agency 2015).

MRONJ (medication related related osteonecrosis of the jaw) is defined by American Association of Oral and Maxillofacial Surgeons as ‘a rare side effect of anti-resorptive and anti-angiogenic drugs. It is defined as exposed bone, or bone that can be probed through an intraoral or extraoral fistula in the maxillofacial region that has persisted for more than eight weeks in patients with a history of treatment with anti-resorptive or anti-angiogenic drugs, and where there has been no history of radiation therapy to the jaw or no obvious metastatic disease to the jaws’ (Ruggiero et al. 2014). Most cases of MRONJ follow a dental intervention, although some cases are spontaneous in nature.

The mechanism of MRONJ is poorly understood but thought to be based around ‘Anti-resorptive drugs inhibition of osteoclast differentiation and function, leading to decreased bone resorption and remodelling’ as the maxilla and mandible have high remodelling rate, it is sensible to think these areas will be adversely effected.

With Anti-angiogenic drugs targeting the processes by which new blood vessels are formed and are used in cancer treatment to restrict tumour vascularisation, this also restricts bone vascularisation.

Unfortunately, both BRONJ and subsequently defined MRONJ cause the affected patients significant morbidity in the form of pain, soft tissue infection and swelling, numbness, paraesthesia or exposed bone.

Rogers suggested the median duration of administration until onset of BRONJ was 3 years in those treated intravenous and 4 years in those treated oral bisphosphonates (Rogers et al. 2015).

Patients at risk of MRONJ are often sub-divided (Scottish Dental Clinical Effectiveness Programme 2017) into two categories:

1. ***Low risk (isolated osteoporosis patients with no other co-morbidities, oral medication with a treatment span less than 5 years)***
2. ***High risk (cancer patients, previous MRONJ patients, cumulative drug dose (also linked to duration of drug treatment), concurrent treatment with a bisphosphonates and a anti-angiogenic medication, systemic glucocorticoids, following invasive dento-alveolar surgery and mucosal trauma (i.e. ill-fitting dentures).***

It is suggested that the timing of dental treatment for patients receiving six monthly IV bisphosphonates or an anti-angiogenic medication should be the month before the next planned infusion.

All strategies should be implemented to reduce the number of patients experiencing MRONJ from both categories.

Aims & Objectives

The aim of this project is to retrospectively assess the experience and treatment outcomes of 100 patients taking bone-modulating medications who were referred for oral surgery treatment in Royal Albert and Edward Infirmary OMFS unit (RAEI). We hope to determine what percentage of patients go on to develop MRONJ and identify if there are any common features in those patients. We plan to review treatment provided for the different stages of the disease and any factors that limit the recovery of these patients.

The objective of the study was to discover the current care we provide to MRONJ patients by:

1. Identifying the referral pathway for these patients.
2. Identifying the medical history of these patients.
3. Identifying the stage of disease they go on to develop.
4. Identifying interventions provided for these patients.
5. Identifying outcomes following intervention for MRONJ.

Standards from the Literature

A literature review found several standards for the management of oral surgery patients at risk of MRONJ. (Malins 2015) following the recommendations of (American Association of Oral and Maxillofacial Surgeons 2014) suggested;

1. 100% of patients taking anti-resorptive medications should be given a supply of 0.2% chlorhexidine mouth wash 10ml four time per day for a minimal of 14 days following treatment.

2. 100% of patients having a surgical procedure should receive Metronidazole 200mg TDS for 5 days or co-amoxiclav 250/125mg TDS for 5 days.

3. 100% of patients taking anti-resorptive medications should have a clinical follow up within 6 weeks.

(Damm and Jones 2013) recommended a drug holiday of two months following the last dose of oral bisphonates as they determined this point the serum free-level of oral bisphosphonate would be acceptably low. This is most relevant in patients who have taken bisphosphonates for greater than 4 years.

The published guidance in ‘National study on avascular necrosis of the jaws including bisphosphonate-related necrosis’(FGDP 2012) and ‘Dental Management of Patients Prescribed Bisphosphonates - Clinical Guidance’ (Malins 2015) have now both been superseded.

The subsequent publication in March 2017 of Oral Health Management of Patients at Risk of Medication-related Osteonecrosis of the Jaw (Scottish Dental Clinical Effectiveness Programme 2017) modified these recommendations, a summary list is stated:

'Do not prescribe antibiotic or antiseptic prophylaxis following extractions or other bone-impacting treatments specifically to reduce the risk of MRONJ.'

'Do not prescribe antibiotic or antiseptic prophylaxis unless required for other clinical reasons'

The (Scottish Dental Clinical Effectiveness Programme 2017) recommendations therefore significantly reduced the value of assessing pre treatment protocols and outcomes for this project.

However conclusions regarding management strategies for patients who developed MRONJ are still very relevant as a Cochrane Review on the treatment strategies of MRONJ in 2016 remained inconclusive stating further research was required (Rollason et al. 2016).

The aims of all treatment should be patient centred, many surgical and non-surgical treatment modalities available for the management of MRONJ.

(El-Rabbany et al. 2017) concluded from a systematic review and meta analysis that there are higher odds of resolving MRONJ with surgical treatment compared with medical treatment alone, (Weber et al. 2016) suggests the use of Er:YAG laser surgery and low-level laser therapy show superior results when used in combination with antimicrobials in the early stages (Stages 1 and 2 (Ruggiero et al. 2014)) of MRONJ. (Rodriguez-Lozano and Oñate-Sánchez 2016) stated 'it still recommended that the management of MRONJ should be decided according to the stage of the disease – conservative treatment being preferred in early stages without symptoms, while surgical management is preferred in the case of bone exposure with symptoms.'

The effectiveness of other therapies, such as bisphosphonate drug holidays (Hasegawa et al. 2017), teriparatide, and hyperbaric oxygen, was uncertain (Rollason et al. 2016). Although there is a recognised medium to high risk of bias within these results and therefore high-quality research is required for conclusive statements to be made regarding treatment strategies for management of MRONJ (El-Rabbany et al. 2017).

Method

Identification of patients who presented as new patients taking anti-resorptive or anti-angiogenic agents requesting or having under gone interventional oral surgery treatment was carried out. Retrospective review of all referral letters, hospital clinical notes, correspondence letters and operation notes was carried out for 100 of these patients. Data collection incorporated patients from May 2015 until December 2016, in order to reach the required 100 MRONJ patients.

Sample / Population

The 100 case notes of patients seen in the department were selected and examined according to the following criteria:

- Whether an anti-resorptive or and anti-angiogenic agent had been taken by the patient for a minimum of one month.
- An invasive oral surgery procedure had been proposed within the previous three months.
- Whether the patient was seen in the department at least twice excluding the pre treatment assessment visit.

Exclusion criteria:

- Any patient who had head and neck radiotherapy in addition to their anti-resorptive or and anti-angiogenic agent.
- Patients that refused invasive oral surgery treatment following consultation.
- Any patient who was unaware of pre-existing signs of MRONJ before invasive oral surgery treatment as no time line or causative event can be accurately concluded.
- Post-operative alternative pathology diagnosed to explain MRONJ symptoms.

Data Collection

Data was collected on name of drug, duration, mode of administration, other relevant medical history, treatment undertaken with LA, IV Midazolam sedation or GA, stage of MRONJ developed according to (Ruggiero et al. 2014), post operative management and length of follow up.

The data was entered anonymously into a spreadsheet and analysed accordingly, see appendix 1.

Results

The overall flow of data is described diagrammatically in figure 1.

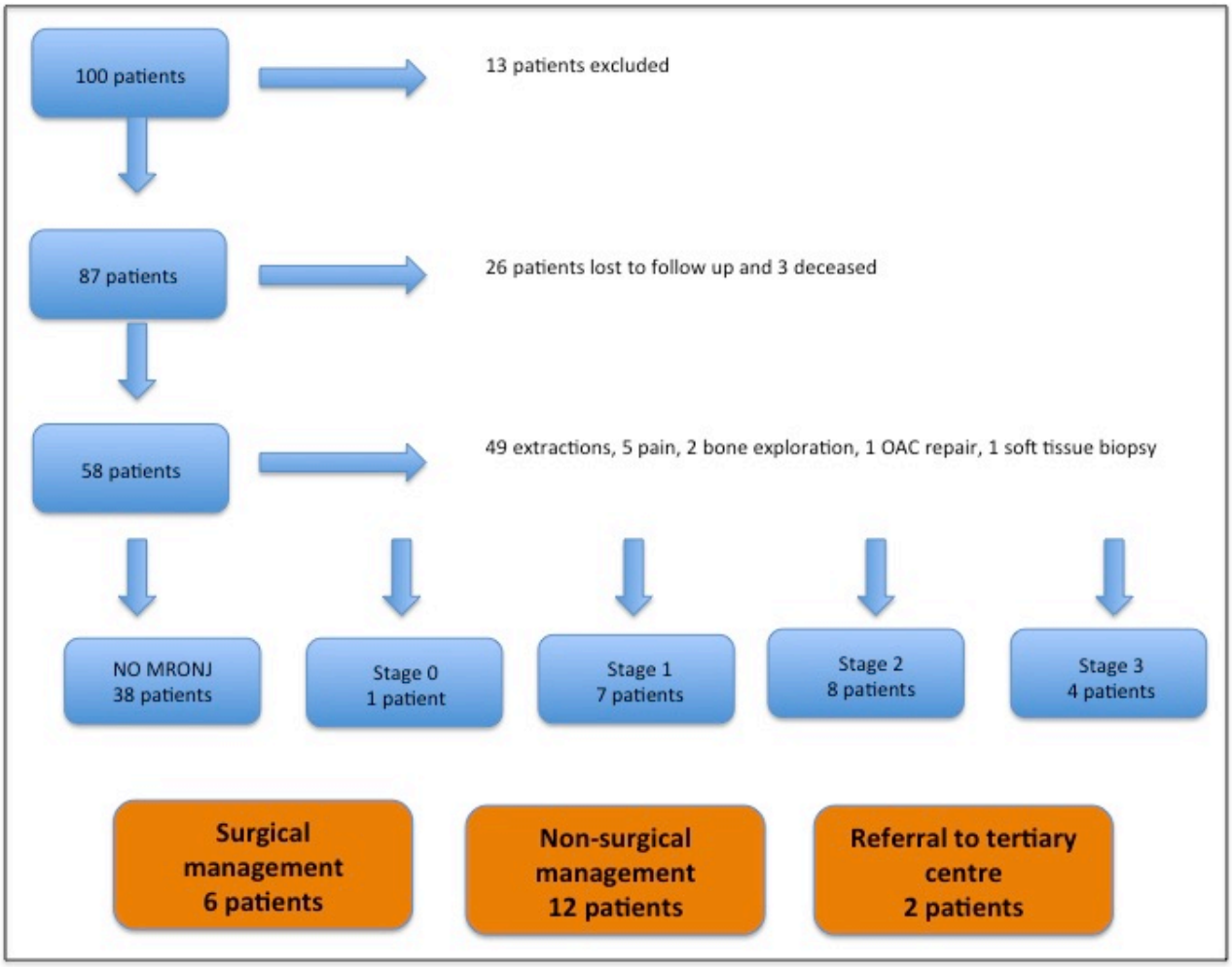
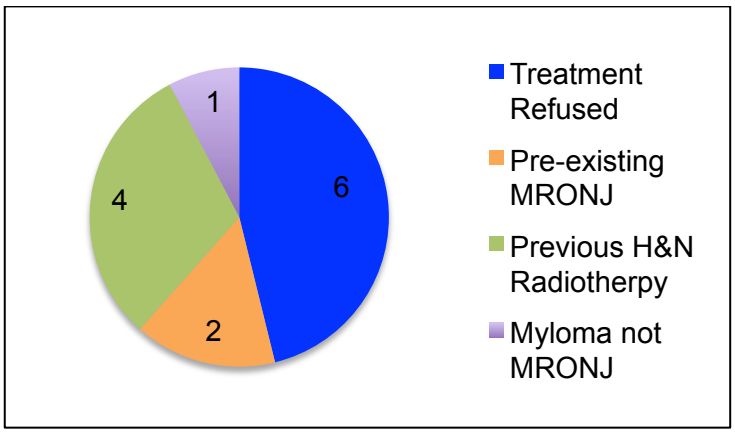


Diagram 1: MRONJ case notes data flow chart.

Data was collected from one hundred patients' records; thirteen records were initially excluded,

Graph 1: Six patients refused treatment following consultation,
Two patients had pre existing MRONJ disease,
Four patients had previous head and neck radiotherapy,
One patient had diagnosis proven myeloma rather than MRONJ post operatively).



Graph 1: Reasons and related number of initial exclusion.

The remaining eighty-seven patients;

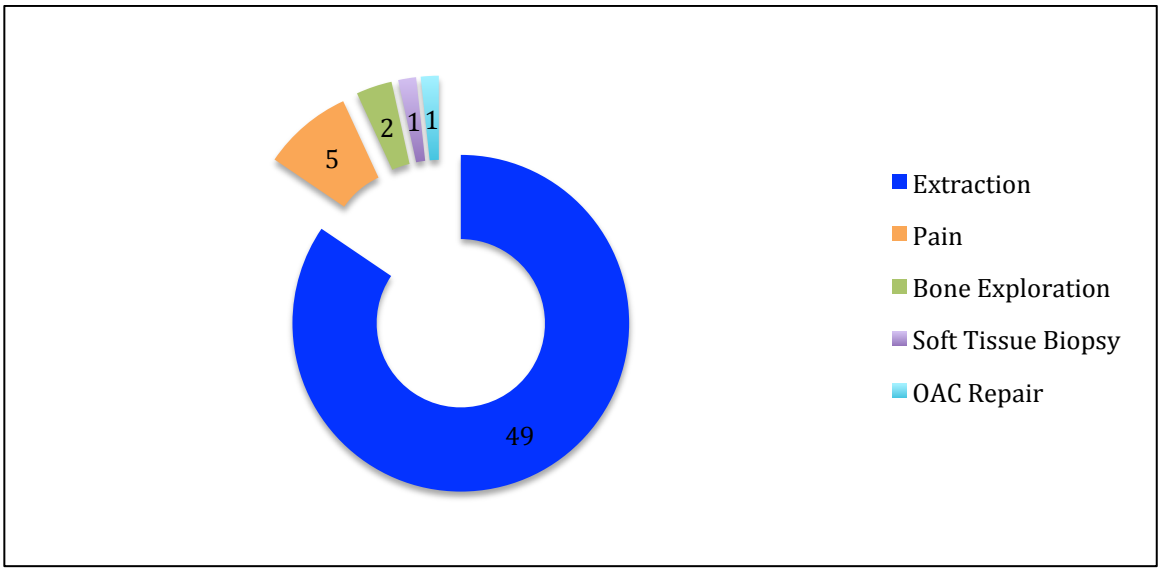
Three died before follow up was possible.

Twenty-six patients were lost to follow up in a combination of DNA's and cancellation of review appointment at patients request.

Fifty-eight patients; Forty-four women and fourteen men were referred to the department, Fifty-five by their GDP, two by oncology services and one by ENT.

The patient's ages ranged from 20 to 104 years, with a mean age of 68 years.

Forty-nine of these patients were referred for extraction, five patients for pain, two for bone exploration, one for OAC repair and one for a soft tissue biopsy, as shown in graph 2.



Graph 2: Reasons for initial referral

Of the five patients referred for pain; three of the patients have been on monthly IV Zolendronic Acid (ZA) and two were on weekly oral Alendronic Acid (AA).

One of the five pain patients, who was on IV ZA recorded discomfort in the right angle of mandible region following extraction of lower right 8, by his GDP 6 weeks earlier. Following mechanical debridement, he suffered a pathological fracture of the mandible, haemorrhage from his facial artery and paraesthesia due to stage 3 MRONJ development. This patient was subsequently referred to a tertiary OMFS unit.

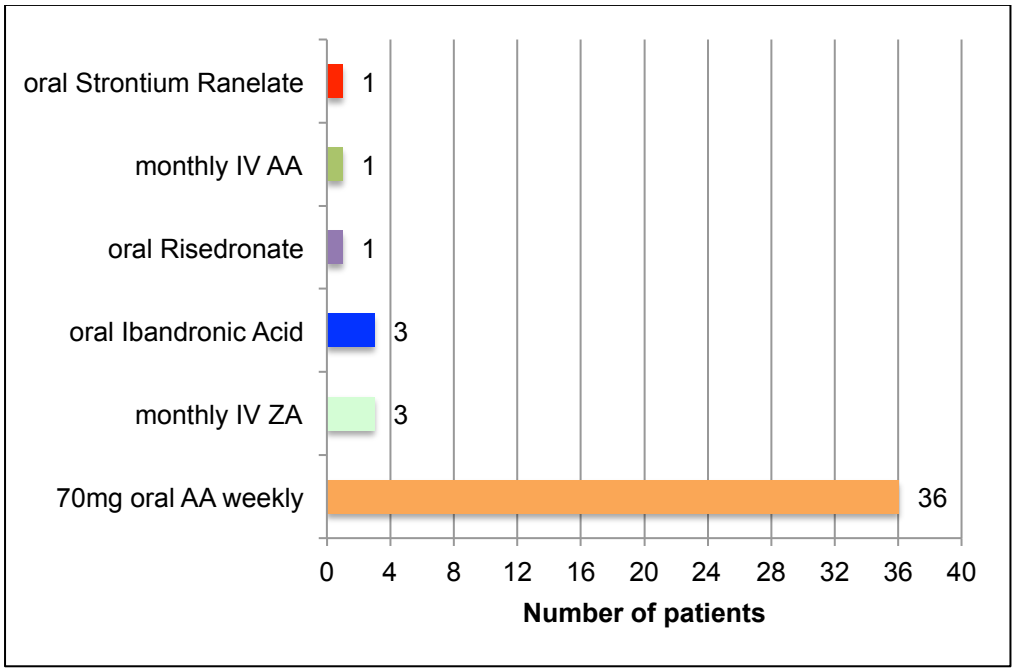
A forty eight year old male, was seen for pain following biopsy of a swelling. The patient was taking weekly oral AA for osteroperosis and also suffered with alcohol and IV drug misuse. MRONJ developed spontaneously at stage 2, this was initially treated with mechanical debridement followed by oral Clindamycin only, this patient then went on to develop stage 3 MRONJ before being lost to follow up.

Of the other three pain patients; two (one ZA, one AA) underwent successful surgical debridement and one listed for surgery but showed signs of healing and therefore no surgery was undertaken.

The two patients for bone exploration, one had taken monthly IV ZA for eight years, suffered stage 2 MRONJ post exploration. This was unsuccessfully treated via local surgical resection and was then referred onto a tertiary care in a regional OMFS oncology service. The second patient took weekly oral AA for an unknown duration. MRONJ stage 2 developed post exploration, local bone resection lead to oral cutaneous fistula which the patient died with before curative management to be undertaken.

Both of the patients referred for OAC and soft tissue biopsy developed stage 1 MRONJ and were successfully treated with oral antibiotics and antimicrobial mouthwash alone.

Of the forty nine extraction patients; One patient was taking daily oral Strontium Ranelate, Three were taking monthly IV ZA, One taking monthly IV AA, three taking oral Ibandronic Acid, Three taking weekly oral Risedronate, Thirty six were taking 70mg oral AA weekly, shown in graph 3.



Graph 3: Medications taken by extraction patients.

The medications taken by the forty nine extraction patients were for multiple reasons, six for breast cancer, two for multiple myeloma, one was been treated for Behçet's disease, one for prostate and liver mets, with one patient each for osteogensis imperfecta, osteopenia and osteoathrtitis with thirty for osteoporosis.

Of the forty-nine patients that underwent extractions, one patient suffered stage zero MRONJ, a male on oral AA, this was managed conservatively with oral antibiotics (co-amoxiclav 1 week), patient the failed to attend their follow up appointment.

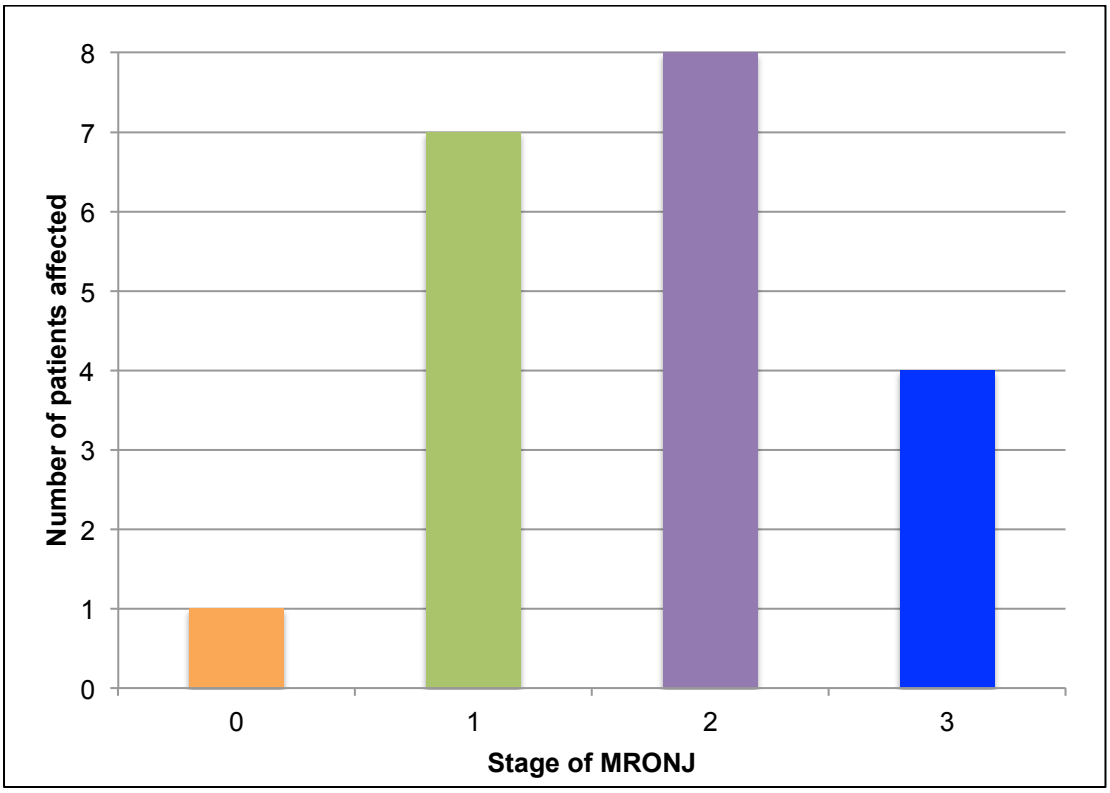
Five suffered stage 1 MRONJ and were five taking oral AA, two taking IV ZA. These were all treated successfully with non-surgical management.

Five suffered stage 2 MRONJ, (three taking IV ZA, two taking oral AA) two of these patients were treated non surgically with a combination of oral antibiotics and antimicrobial mouth washes, one had spontaneous exfoliation of bone sequestrum without any intervention and spontaneous soft tissue healing.

Two further stage 2 patients had surgical management, one with mechanical bone removal with “bone rongeurs” the other patient had bone removal with a surgical bur.

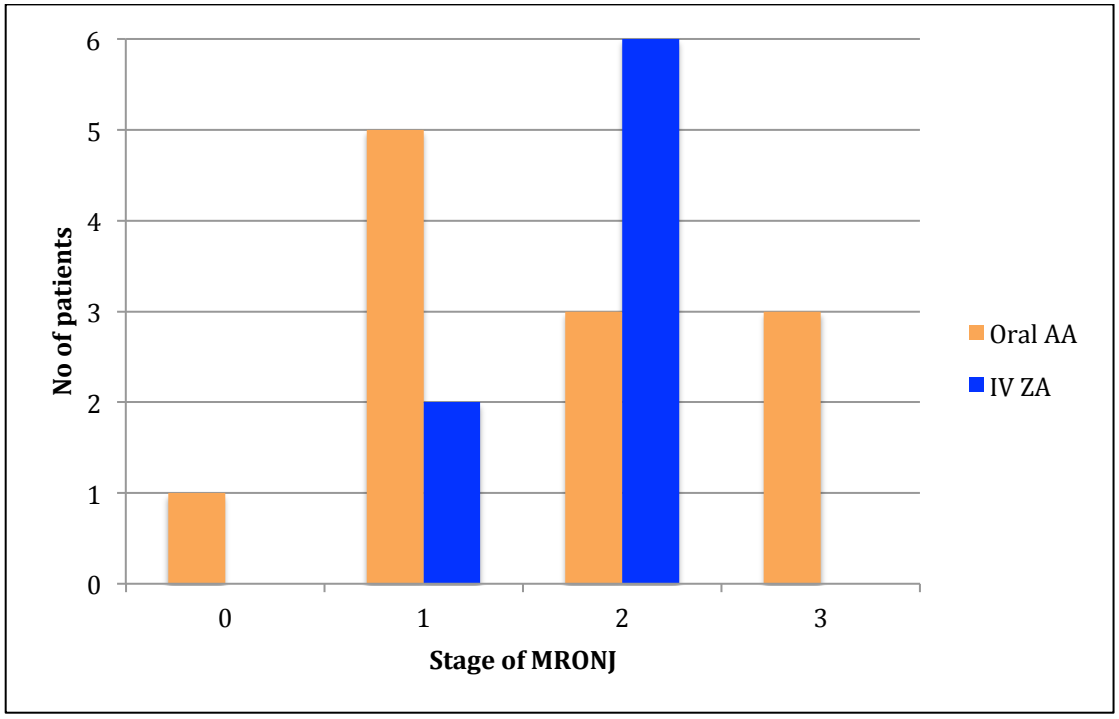
In the mechanical bone removal patient (IV ZA) soft tissue healing and symptom relief was achieved in four months.

The patient who underwent bone removal with a surgical bur (taking oral AA), went on to develop stage 3 MRONJ, the maxilla become mobile and he died with an obturator in situ, MRONJ was not deemed to be the cause of death.



Graph 4: stages of MRONJ and number of patients affected.

Graph 4 shows the numbers of RAEI patients diagnosed with MRONJ over the test period. There were 12 patients in the cohort who combined suffered with Stages 2 and 3 MRONJ. This was seen in equal numbers of patients taking IV and oral medications, over a range of eighteen months to five years. All of the MRONJ seen was in patients taking either oral AA or IV ZA, graph 5. Other medications being taken included strontium ranelate, ibandronic acid and risedronate. In this cohort of patients, these other medications did not result in MRONJ occurrence.



Graph 5: Medications and stages of MRONJ

Twice as many females as males were affected; age range of patients affected was from 51 – 84 years. Five patients had dental extractions in the department, with four patients having dental extractions at their own GDP before been referred in to the department. Three patients were referred in to the department with no history of dental extractions but with swelling and pain.

There were equal numbers of oncology and osteoporosis patients, most common co-morbidity was hypertension reported by 9 of the 12 patients, also of note was over 50% of the patients suffered with peripheral or central vascular disease.

Ten out of the twelve patients had all of their treatment carried out under local anaesthetic, with two having a combination of general and local anaesthetic. Follow up period to review symptoms in general ranged from two to six weeks, one patient was seen after 12 months but this was a referral from ENT.

From the five operation notes available for patients who had extractions in the department, there was no reported mechanical or surgical bone removal during the extraction.

Six patients had no surgical intervention, whereas the other six patients had necrotic bone removed as a delayed procedure, five had mechanical bone removal with bone file or rongeurs with one patient having the bone removed with a surgically irrigated bur.

From the twelve patients, two MRONJ sites never healed continuing to have symptoms in the follow up period of the study. Two patients had sequestrae of bone, which self exfoliated and healed within 6 weeks, with six other patients healing between four to six months following an intervention. The final two patients died without resolution of MRONJ.

Discussion

This study found, like many, difficulty in patient retention. This is likely due to age and patient perception. When there is a lack of symptoms, patients adopt an 'I don't want to waste your time attitude' which has been evident in this generation of patients.

It was also difficult to always ascertain the treatment duration of patient's medications, making it difficult to categorise patients into high or low risk of MRONJ. This could be an issue with the patient's general medical practitioner records or discrepancy with the patients' recollection.

In addition to this it was evident from our results that all of the MRONJ seen at RAEI was through taking either oral AA or IV ZA. This is likely to be due to the small study size as well as the fact that AA and ZA are the most commonly prescribed drugs for osteoporosis and chemotherapy for oncology patients.

Comparison with published literature

The data collection showed variable results compared to the literature, but with such a small sample this is not unexpected.

As demonstrated, the patients affected by MRONJ are not only those who undergo dental extractions, but the condition is also seen following bone or soft tissue biopsy as well as spontaneous onset.

RAEI results show MRONJ can be successfully treated both surgically and non-surgically, however, often with long-term antibiotics and follow-up. There is also evidence that the patients may lose their battle with their underlying pathology before MRONJ is successfully treated. The literature suggests surgical intervention has a better outcome, this could not be proven using RAEI data.

RAEI results discovered similar rates of MRONJ in patients taking oral and IV drugs, whereas the literature provides widespread evidence of IV patients been at a far higher risk. It should not be forgotten that many oral patients are now treated in primary care, so this may not be a fair reflection of incidence.

Only one patient in our cohort had a three-month 'drug holiday' and displayed no complications, therefore 'drug holiday' validity can not be commented upon.

Teriparatide (Recombinant DNA form of parathyroid hormone), hyperbaric oxygen, Er:YAG and low-level laser therapy are not available in RAEI OMFS department, therefore the results cannot be used to comment on the potential treatment value of these modalities.

It is worth considering that due to the relatively low numbers of patients affected with stage 3 MRONJ and high risk patients with stage 2 MRONJ, it would be better for these patients to be referred sooner rather than later to tertiary OMFS centres that regularly undertake OMFS oncology resections, rather than district general and dental hospitals attempting to manage such patients.

Conclusions

In conclusion, from the 100 sets of case notes reviewed, table 1 shows the number of patients affected by different stages of MRONJ, wide variation was seen in their presentation, disease progression, treatment and overall outcome.

Stage of MRONJ	Number of patients effected
0	1
1	7
2	9
3	3

Table 1: stages of MRONJ and number of patients affected.

As the retrospective case note review had a very low numbers, it is difficult to draw any definitive conclusions, however the sample did show the risk of MRONJ identified 26.5% (13 out of 49 extraction patients). The high percentage doesn't take into account all the successful extractions that are undertaken in primary care, where no OMFS input is required.

The most common comorbidities have been identified as hypertension 75% and peripheral or central vascular disease seen in over 50% of patients.

It was demonstrated that no single treatment modality was used in the management of MRONJ. This condition remains a very difficult one to manage, there are many treatment modalities, but not yet enough research to agree on a standard management approach of the different stages. Unfortunately the treatment duration remains prolonged for many patients, with some referred for large and cosmetically debilitating resections for pain and infection relief, whereas some lose their life due to other co-morbidities before MRONJ is successfully treated.

Far more preventive education for patients and healthcare staff is required to help optimise oral health before such potentially locally destructive medications are prescribed.

When MRONJ does happen, the aims of all treatment should be patient centred and indicators of successful treatment, should revolve around:

1. Improving patient's quality of life.
2. Pain management
3. Infection control
4. Management and prevention of bone necrosis progression.

These results show that more research is needed into MRONJ and specifically around the patient's perception of treatment received and how this impacts on their quality of life.

Information dissemination and follow up intentions

I plan to disseminate results to the audit co-ordinator, with the provisional plan of:

- Dissemination of results to all OMFS clinical staff, in department audit meeting and local GDP's, via an LDC meeting.
- Reinforcement of key messages via departmental morbidity and mortality meetings.
- Re-audit of the departments MRONJ management strategies.
- Possible development of a local protocol for management of MRONJ

Action Plan		
Key Action	**Co-ordinator for action**	**Timescale**
Dissemination of Results	Adam Bhanji	October 2017
Re-Audit of MRONJ	Ragu Mani	August 2019
What was the main matter(s) of concern this clinical audit has identified?		
1. Inconsistent in record keeping of drug duration. 2. Difficult in identifying patients before MRONJ affects patients. 3. The high patient numbers who do not complete their MRONJ treatment due to been lost to follow up or dying with residual disease. 4. Inconsistent in management strategies used for patients suffering with MRONJ.		

Bibliography

American Association of Oral and Maxillofacial Surgeons. (2014). Medication-Related Osteonecrosis of the Jaw—2014 Update, White paper. *J Oral Maxillofac Surg*, 1(72), pp.1938–1956.

Damm, D.D. and Jones, D.M. (2013). Bisphosphonate-related osteonecrosis of the jaws: a potential alternative to drug holidays. *General Dentistry*, 61(5), pp.33–38.

El-Rabbany, M. et al. (2017). Effectiveness of treatments for medication-related osteonecrosis of the jaw: A systematic review and meta-analysis. *Journal of the American Dental Association (1939)*, 148(8), pp.584–594.

European Medicines Agency. (2015). Further measures to minimise risk of osteonecrosis of the jaw with bisphosphonate medicine. [online]. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Press_release/2015/03/WC500184865.pdf [Accessed October 9, 2017].

FGDP. (2012). National study on avascular necrosis of the jaws including bisphosphonate-related necrosis. [online]. Available from: https://www.fgdp.org.uk/sites/fgdp.org.uk/files/docs/in-practice/amps-online/final%20report-27.11.12.pdf [Accessed January 9, 2017].

Hasegawa, T. et al. (2017). A multicenter retrospective study of the risk factors associated with medication-related osteonecrosis of the jaw after tooth extraction in patients receiving oral bisphosphonate therapy: can primary wound closure and a drug holiday really prevent MRONJ? *Osteoporosis international: a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA*, 28(8), pp.2465–2473.

Malins, T. (2015). Dental Management of Patients Prescribed Bisphosphonates - Clinical Guidance. [online]. Available from: https://www.england.nhs.uk/mids-east/wp-content/uploads/sites/7/2015/03/bisphosphonates-guidelines-2015.pdf [Accessed May 2, 2017].

Rodriguez-Lozano, F.-J. and Oñate-Sánchez, R.-E. (2016). Treatment of osteonecrosis of the jaw related to bisphosphonates and other antiresorptive agents. *Med Oral Patol Oral Cir Bucal*, 21(5), pp.595–600.

Rogers, S.N. et al. (2015). United Kingdom nationwide study of avascular necrosis of the jaws including bisphosphonate-related necrosis. *The British Journal of Oral & Maxillofacial Surgery*, 53(2), pp.176–182.

Rollason, V. et al. (2016). Interventions for treating bisphosphonate-related osteonecrosis of the jaw (BRONJ). *The Cochrane Database of Systematic Reviews*, 2, p.CD008455.

Ruggiero, S.L. et al. (2014). American Association of Oral and Maxillofacial Surgeons position paper on medication-related osteonecrosis of the jaw--2014 update. *Journal of Oral and Maxillofacial Surgery: Official Journal of the American Association of Oral and Maxillofacial Surgeons*, 72(10), pp.1938–1956.

Scottish Dental Clinical Effectiveness Programme. (2017). Oral Health Management of Patients at Risk of Medication-related Osteonecrosis of the Jaw. [online]. Available from: http://www.sdcep.org.uk/wp-content/uploads/2017/04/SDCEP-Oral-Health-Management-of-Patients-at-Risk-of-MRONJ-Guidance-full.pdf [Accessed October 9, 2017].

Tanna, N. et al. (2017). Awareness of medication related osteonecrosis of the jaws (MRONJ) amongst general dental practitioners. *British Dental Journal*, 222(2), pp.121–125.

Weber, J.B.B., Camilotti, R.S. and Ponte, M.E. (2016). Efficacy of laser therapy in the management of bisphosphonate-related osteonecrosis of the jaw (BRONJ): a systematic review. *Lasers in Medical Science*, 31(6), pp.1261–1272.

Appendix 1: Data collection sheet

Pt. Number	Pt. Initials	Referral Source	DOB	Age	Gender	Reason for referral	Name of Drug	IV / Oral	Frequency

Time period	Tooth in Referral Letter	Radiograph included with referral	Extraction / Post op referral	Cancer / Osteoporosis / Rheumatology	Other MH	Smoking	Carious / Perio

Previous Abs	Method of anaesthesia (LA / IV Sed / GA)	SHO / Staff Grade / AS / Cons	Time of 1st Review	Post op radiograph	MRONJ Stage 0-3

Treatment Provided	Mechanical / Surgical Bone Removal	Notes