

Use of shock waves for the treatment of osteonecrosis of the mandible. A non-invasive approach .

CHOUKROUN Joseph 1 , DISS Antoine 2 , Binderman Itzhak 3 CHENAITIA Hichem 4 , Mariottini Jean Pierre 5

1. MD, Centre Anti- Pain, Nice

2 . Doctor of Dental Surgery , Doctor of Science, Former Intern Hospital of Nice, Nice Private Practice .

3 . PhD, Department of Oral Biology, Maurice and Gabriela Goldschleger School of Dental Medicine , Tel- Aviv, Israel

4. MD, Center of Musculoskeletal Imaging , Nice

5 Doctor of Dental Surgery , Doctor Es Odontological Sciences , Nice.

1 . Introduction

Osteonecrosis are complications encountered waning prescribing bisphosphonates or in the aftermath of radiation treatment of cancer of the cervical area . These conditions are difficult to treat, often disabling and algogenic. This treatment was considered at first analgesic . It was found very rapid pain relief and disappearance of painful phenomena in the second session as well as a significant improvement in bone health and even cure some bone lesions We propose in this clinical review, the use of non-invasive treatment osteonecrosis based on the focal shock waves .

2 . Ostéécroses The

a. Osteonecrosis with bisphosphonates

The massive use of bisphosphonates , as in the treatment of osteoporosis and certain cancers , is responsible for the increased prevalence of osteonecrosis of the mandible and maxilla .

Bisphosphonates are considered as some of the risk factors in oral surgery . Osteonecrosis of the jaw complications are rare but cases accumulate over the years : 94% of reported cases are in cancer patients treated with intravenous bisphosphonates .

Bone is a functional structure which regularly and continuously reshapes slowly in response to physical stress and the metabolic environment . Two related processes, formation and bone resorption, ensure turnover and permanent remodeling. Healing many oral surgeries such as dental extractions, depend on the quality of bone remodeling . Treatment with bisphosphonates has been described as one of the risk factors in maxillofacial surgery. If the alveolar bone has significant concentrations of bisphosphonates , bone turnover is disturbed sharply and causes a significant risk of post-extractionnelle bone necrosis .

Many pathogenic mechanisms have been proposed. A possible mechanism is that treatment with bisphosphonates suppress bone turnover and leads to decreased blood flow and cell necrosis: the bone is unable to repair itself from the trauma and results in osteonecrosis.

The lesion corresponds to an exposure area of the bone, devitalized, with or without infection. The exposed bone has a yellow-white color. Gingiva and oral mucosa devices may be normal or slightly inflamed. But inflammation can be much greater: increased sensitivity, pain can be very debilitating, it can be annoying to food intake and dental hygiene, and potentially associated with local superinfection , edema, presence of sero-purulent fluid. Teeth affected areas can become mobile. Fistulas are present in some cases : they may be skin or mucous membranes.

b . mandibular ORN

This is a mandibular bone necrosis that appears between 6 months and 5 years after irradiation of the cervical region . It is linked to a post-radiation sclerosis of terminal branches of the inferior dental artery which vascularized mandible alone , without network substitution . But the incidence is low (5-10 %) of cases.

Several predisposing factors have been identified : greater than 60 Gy in a mandibular expanded volume , dental caries , gingival denudation linked to irradiation skill too soon after tooth extraction , periodontal advanced , complicated extractions of a cellular infection and carried out in a region mandibular irradiated , interstitial brachytherapy performed without lead adjacent the mandible protection .

Clinically, it is initially manifested by localized pain. Radiographic signs of early in favor of a heterogeneous bone demineralization , progressive extension. At an advanced stage, more severe pain, increased as a result of superinfection often associated , as well as inflammatory edema . Gingival gap may sometimes appear, which are eliminated by the necrotic bone fragments. Radiologically, then there is a sequestrum within a range of demineralization.

c . therapeutic

Treatment is difficult and long, it takes months or even years. It combines analgesics , anti-inflammatory, antibiotics and some HBO .

3 . Extra-corporeal focal shock waves

Extracorporeal focal shock wave therapy was introduced in the medical world about 30 years ago. Since that time, the shock waves have radically changed the treatment of urolithiasis. Today, the shock waves are the first- line treatment for urolithiasis. Focussed shock wave therapy has also been used in orthopedics and rheumatology to treat calcific tendinitis or non-delayed bone healing or nonunion, aseptic osteonecrosis of the femoral head, as well as fractures . The principle of focused shock waves in the context of musculoskeletal disorders is the stimulation of tissue regeneration. The principle is a generator system comprises a shock wave source of electrical energy, a mechanism and an electro- acoustic conversion material to focus the shock wave. There are three techniques for producing shock waves: electrohydraulic, electromagnetic or piezoelectric . The technique used in our study is electrohydraulic. Shock waves are acoustic waves with a high energy in the same way that a plane which passes through the sound barrier in the atmosphere has a high energy peak . The shock waves differ very importantly from ultrasonic by their amplitude, their low frequency, minimum absorption by their tissue and by their lack of thermal effect. In general and in contrast to other applications including urology, trauma shock waves are used not to destroy tissue but to induce neovascularization, so a vascular supply and tissue regeneration. The extracorporeal waves induce cavitation (generation of gas bubbles) in the interstitial tissue microphones producing tissue damage. Microphones damage caused by cavitation may be responsible for part of the therapeutic effect. The mechanisms include an increase in blood flow and the creation of neovascularization in the treated area. Other mechanisms of action of therapies acoustic waves are not yet clear. Experimental data suggest that one of the biological effects induced by mechanical stimulation of the shock wave focal length is the production of nitric oxide (NO) , which is well known to promote angiogenesis .

Angiogenesis itself is an early step in tissue healing. It is induced by a large number of growth factors antigenic. Extracorporeal shock waves represent an innovative alternative in cases where defects healing strong angiogenesis is essential, such as severe skin wounds or ischemic myocardial injury.

In experimental studies in animals, the shock waves promote bone healing, tissue repair by increasing neovascularization and production of antigenic and osteogenic factors such as VEGF (vascular endothelial growth factor) , eNOS (endothelial nitric oxide synthase), PCNA (proliferating cell nuclear antigen) , BMP -2 (bone morphogenic protein -2) and osteocalcin . Several experimental studies have measured the effects of shock waves on bone fractures and cartilage pathologies. Wang et al . (2003) demonstrated on femur fractures in rabbits, as therapies shockwave induced significantly lower bone mineral density (BMD) , a size of callus , a calcium concentration , and superior mechanical strength by compared to controls .

Human clinical studies show the effectiveness of such shock waves in the treatment of aseptic necrosis of the femoral head. The improvement includes a regenerative effect of angiogenesis, osteogenesis and bone remodeling. However, in the latter case, the precise mechanism of shock waves is only partially understood . The most important for the treatment of disorders of bone healing physical parameter appears to be the distribution of the pressure, the density of the energy flow and the total sound energy bone. Thus, the effects of shock waves on bone mass and strength seem to be dose dependent and time . Wang et al . (2001) demonstrated that shockwave treatments increase the formation of bone callus and induce the formation of cortical bone to fracture and in dogs, increasingly with the duration of action of the waves. Conversely , Forriol et al . (1994) , conclude think differently and that the shock wave treatment slows bone healing . These contradictory results could be due to differences in treatment protocols (duration and intensity of the waves). Treatment protocols for extracorporeal focal shockwaves (energy, pulse frequency, intervals between sessions) is not yet clearly defined. For necrosis of the hip, a proposed protocol sessions with 2400 include four pulses at 0.50 mJ/mm² at 48-72 h intervals . In the treatment of non-union , the authors suggest an average energy flux of between 0.22 and 1.10 mJ/mm² , patients according to the tolerances and applied on a series of pulse 4000 while in recent fractures, waves are applied one month after surgery with powers of 0.07 and 0.17 mJ/mm² . The objective is to use low-energy waves to induce an angiogenic effect. The number of pulses is the same as in the case of treatment of pseudarthrosis .

As part of our series of shock waves are applied to the necrotic area, through the skin of the face. Contact gel is applied between the skin and the external probe to avoid energy losses. The probe which transmits shock waves similar to an ultrasound probe. Figure 1: the emitting probe shock wave is applied to the skin facing the mandible necrosis

4 clinics. Case

a. Case 1: bisphosphonate osteonecrosis

This is a patient with osteonecrosis of the mandible following a tooth extraction and treatment with bisphosphonates intravenously. He is a man of 56 years , treated for myeloma in 2006 (chemotherapy + 3 years of bisphosphonate injection IV). In January 2010, tooth # 47 was extracted for endodontic reasons. The site has not properly healed and the patient developed osteonecrosis of the jaw. The patient was then followed in a hospital service maxillofacial surgery scheduled for curettage and successive courses of antibiotics : 2 g of

amoxicillin for 6 successive months . Despite this treatment and suppuration fistula were visible on our initial consultation (Figure 2: Initial clinical osteonecrosis to 1 year after the extraction of the 47 : the gingiva is edematous , and a fistula where s ' flows a stream of pus) the panoramic radiograph shows a characteristic appearance in wet sugar signing chronic osteomyelitis (Figure 3 . panoramic radiography . appearance of osteomyelitis of the site of the tooth 47).

Curettage is then performed in a gentle way to debride the area. Adjuvant focal shock wave is initiated. The generator used is the brand CellSonic (CellSonic Medical Dental machine CellSonic Ltd PO Box 30019 , Al Hamra , RAK , UAE) . The outer right side of the mandible was treated with 1000 pulses with an energy of 0.1 mJ/mm² for each treatment cycle. A total of 3 cycles was performed every 3 weeks (Figure 4: Treatment protocol for extracorporeal shock wave : a total of 3 sessions impacts 1000 spaced 21 days was performed). From the 15th day after the first cycle, we see a cessation of suppuration, drying fistula still present and decreased inflammation (Figure 5 : Clinical Monitoring 15 days after the first treatment session: the fistula dry.) . Control 2 months: between the second and third cycle we find a complete wound closure and a total cessation of suppuration (Figure 6 : Clinical control 2 months: closure of the fistula) . The pain has completely disappeared. Radiologically controlled at 1 year showed complete healing of the site. (Figure 7: complete bone healing of the necrotic)

b . 2nd case : Osteoradionecrosis

52- year history of cervical cancer with lymph node involvement, operated and irradiated with 90Gy of dosa . It develops in the following year an extensive bilateral Osteoradionecrosis mandible with spontaneous double fracture (bilateral), complicated by renal failure requiring renal replacement therapy (dialysis) . The pain is very intense and the power is only possible through a gastrostomy tube. Analgesic treatment is based on opioid analgesics.

The patient is treated by a 2000 session impacts every month (1000 per hemi- mandible) , at a dose of 0.1 mJ / mm² with gradual increase in energy up to 0.147 mJ / mm² for the last session.

Clinical improvement occurs in the first session with decreased pain. The pain disappeared completely after the second session: stop opioid analgesics .

We conducted six sessions a month apart. The radiological improvement is progressive with a mandibular fracture healing and radiological improvement of the appearance of necrosis.

Figure 8: mandibular osteonecrosis extended with double fracture Figure 9: 2 Healing fractures. Marked improvement in bone structure Figure 10: Scanner scans the 4th month: ongoing healing of the fracture.

c . Case 3 : Osteoradionecrosis

Man of 62 years , cervical cancer , operated and irradiated with a dose of 60 Gy It has osteonecrosis of the left mandible with fistula to the skin. It is treated with morphine patch (Fentanyl ®) continuously. A wave treatment focal shock is started (1200 impacts per monthly session at a level 0.121 mJ / mm² with increased power to 0,147 mJ / mm² (max) . Clinical improvement (pain) is immediate. Judgment painkillers. after the 2nd meeting fistula dries in 2 months Figure 11 . fistula next necrosis Figure 12 . cutaneous fistula healing Figure 13 with severe osteonecrosis complete osteolysis of the mandibular symphysis region to the right angle with continuity solution back at the ramus for a sequestrum Figure 14 Early consolidation with bone formation and increase bone thickness of the ramus ,

image persistence bone receiver, forming " bridge" or bony bridges between the symphysis region at the upper and lower corner and the branch right rising

discussion

Osteonecrosis of the jaw is problematic in terms of support , which remains on time today difficult and complex. This condition affects significantly the quality of life of the patient and sustainable manner. The main source of discomfort is the pain experienced by patients with the disease. Extra-corporeal focal shockwave therapy equipment is non-invasive, easy to implement, inducing few side effects, no special npn-indications, and very inexpensive. This technique is increasingly integrated into the general framework of regenerative medicine in the articular bone area. The results of numerous studies confirm its action through the stimulation of repair of bone lesions with stimulation of bone formation in the context of nonunion or osteonecrosis. Its analgesic effect, although still not fully explained, is found in most of the study results. This analgesic effect is essential in the management of these patients. This therapeutic approach although recognized in many countries and even more reimbursed by health authorities, remains very uncommon. The recent possibility of radiological guidance in bone pathologies seems relevant when the lesions are focused, but this significantly increases the cost of the equipment remains an important development of this technical obstacle. Focal shockwave therapy seems an interesting therapeutic under the management of osteonecrosis and fits within the limited armamentarium of treatment of these pathologies

Limitation of the study

We have described a series of three clinical cases of mandibular osteonecrosis treatment with extracorporeal focal shock waves. Randomized double-blind controlled studies are needed to confirm the efficacy of this treatment for this type of pathologies, standardization of protocols based devices focal shock waves and pathologies seems necessary.

Conclusions

Treatment with extracorporeal shock waves of jaw osteonecrosis could be an adjuvant treatment to surgical treatments. Of course, other studies have confirmed the efficacy of this type of care and especially refine the therapeutic protocol.

The main effect we were looking at was originally analgesia. The assumption was that the pain was first ischemic pain. It seems that this technique can provide rapid and lasting analgesic effect by revascularization at the same time as improving bone healing necrotic effect.