ORTOVOLTAGE THERAPY IN PAIN TREATMENT

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INTRODUCTION

- Orthovoltage is a type of radiation therapy that has been available for more than 60 years.
- As recommended by IAEA/ESTRO, each radiotherapy department should have one orthovoltage machine.
- The X-rays used in this treatment are strong enough to kill cancer cells, but do not penetrate more than a few millimeters to few centimeters beyond the surface of the skin, making it an effective treatment for very superficial tumors.

INTRODUCTION

- Orthovoltage is an excellent non-invasive alternative to surgery for skin cancer in sensitive locations, such as the folds of the nose, eyelids or ears.
- Some breast cancers
- Also used for metastatic bone disease (ribs, spine, etc).

RADIOTHERAPY IN NON-MALIGNANT DISEASE TREATMENT

- In addition to the treatment of malignancies, radiotherapy is successfully applied in the treatment of certain non-malignant diseases, such as:
  - benign tumors,
  - vascular disorders,
  - inflammatory and degenerative diseases,
  - systemic diseases, etc.

EFFECTS OF RADIATION

- The *radiobiological mechanism* of the effect of radiation on benign diseases has not been fully elucidated.
- Several hypotheses of therapeutic effect of radiation:

a) perfusion theory- increased capillary permeability ;

b) ferment theory - destruction of inflammatory cells and release of mediators;

c) neuroregulatory theory-impact on the autonomic nervous system;

d) electrochemical theory-influence on the structure of the tissue milieu and

e) antiproliferative theory-prevention of mitotic activity of proliferating cells.

MECHANISM OF RADIOTHERAPY

- The therapeutic effect of RT is the result of the interaction of several of these mechanisms of radiation effect on different types of target cells.
- For various benign diseases radiation dose can vary significantly.
- In order to achieve the optimal therapeutic effect, it is necessary to apply the prescribed radiation dose to the target volume over an *appropriate period of time*.

RT FOR BENIGN DISEASES

- The therapeutic dose and the number of fractions need to be precisely determined.
- Risk organs and their protection need to be defined.
- The choice of radiation energy depends on the localization of the target volume.
- Radiation therapy for benign diseases in young people is performed only exceptionally.
- Certain organs, such as thyroid, eye, gonads, bone marrow and breast, are particularly sensitive and should be avoided.

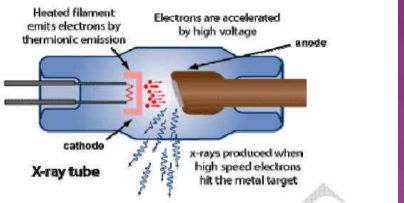
ORTHOVOLTAGE X-RAY MACHINE

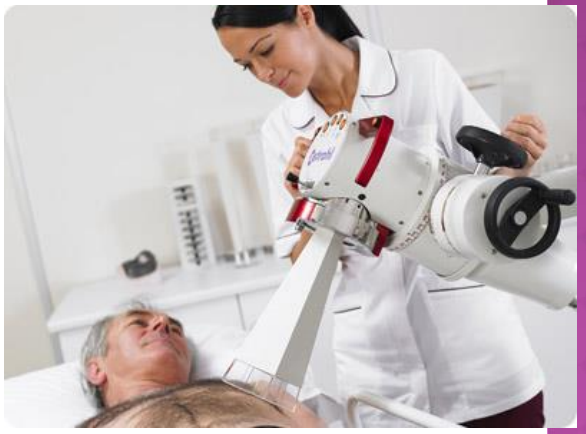
- The radiation energies used in orthovoltage X-ray therapy range from 50 to 300 kV.
- Radiation therapy (kilovolt) radiotherapy apparatus can be classified in many ways, but most often and best is to classify these devices by the energy of the emitted X-ray and the focal-skin distance (FKD), which is the distance between the true or apparent focus of the x-ray tube and the patient's skin.

X-RAY MACHINE(KV)

- ORTHOVOLTAGE TELERADIOTHERAPY:

1. Contact RTG TH: voltage 15-50 kV; FKD = 0.5 - 5 cm
2. Surface RTG TH: voltage 60 - 120 kV; FKD = 15-30 cm
3. Medium-deep RTG TH: voltage 120 - 140; FKD = 30 - 50 cm
4. Deep RTG TH: voltage 140 - 400 kV; 40 - 70 cm





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INDICATIONS OF RADIOTHERAPY

The following disease groups are addressed:

- hyperproliferative disorders,
- symptomatic functional disorders and
- painful degenerative skeletal disorders.

Seegenschmiedt MH.et al.Br J Radiol 2015

HYPERPROLIFERATIVE DISORDERS

Desmoid tumors /aggressive fibromatosis

- Locally invasive low-grade tumors deeply infiltrate surrounding healthy tissue-PAIN
- TH: Surgery
- ***local recurrences*** occur frequently
- Successfully treated with reoperation or postoperative radiation.
- TD 50-60 Gy

Peyronie's disease (induratio penis plastica)

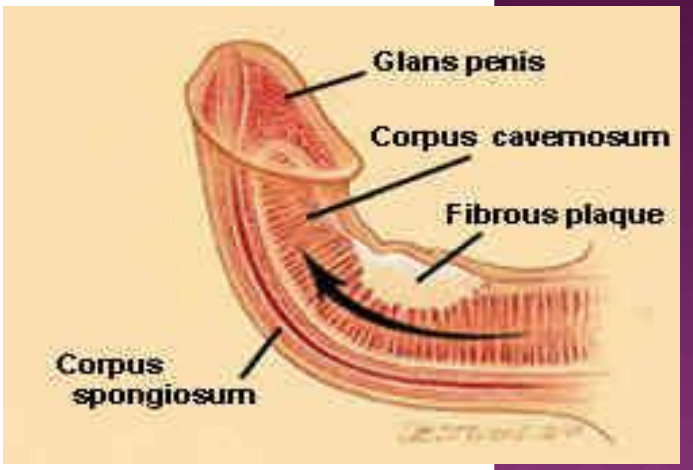
- It is manifested by more or less pronounced fibrosis of the connective tissue of the penis
- Painful curvature of the penis in an erection, which prevents copulation.
- Therapy:

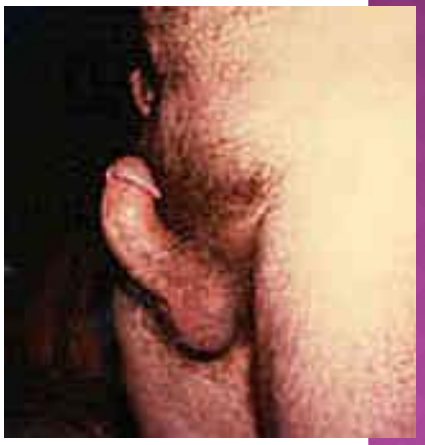
  -medications,

  -physical therapy,

  -radiation or

  -by surgical therapy.
- The use of X-ray therapy is effective and accelerates the withdrawal of PAIN.
- Therapeutic radiation doses range from 5 Gy applied in one fraction (treatment can be repeated in a month) or 18 to 21 Gy administered in 6 to 7 fractions.





Morbus Dupuytren/ Morbus Ledderhose

- Thickening of the palmar aponeurosis of the hand, with flexion contracture of the 4th and 5th fingers.
- The use of radiation in the ***early stages*** of the disease gives a good therapeutic effect and pain relief.
- A dose of 20 Gy in 10 fractions

Keloids

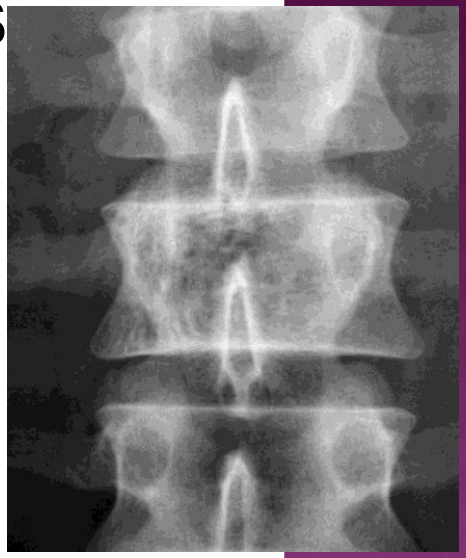
- They are formed by the formation of fibrous tissue that spreads across the borders of the wound.
- It often relapses after surgery.
- Therapy is surgical excision ***combined with radiotherapy***
- Radiotherapy should be started within 24 hours of excision. A dose of 12 to 20 Gy is administered to the operating scar, in 3 to 5 fractions per week.

Aneurysmal bone cyst

- The etiology is unknown
- Growth leads to compression of surrounding tissues and organs with pain syndrome
- Therapy: resection
- Radiotherapy has been successfully used in patients whose lesions are *inoperable, difficult to reach, or repeatedly relapse.*

TD 30-40Gy

Symptomatic vertebral hemangiomas



- Expansion into extradural space
- Hemorrhages or fractures with compression of the medulla
- Less extensive surgery is usually performed in combination with postoperative radiation, or radiotherapy is used as the unique treatment.
- By RT 30 to 40 Gy is applied to the target volume in 4 to 6 weeks.
- ***Complete pain relief 61.9%*** and partial pain relief in 28.6%

SYMPTOMATIC FUNCTIONAL DISORDERS

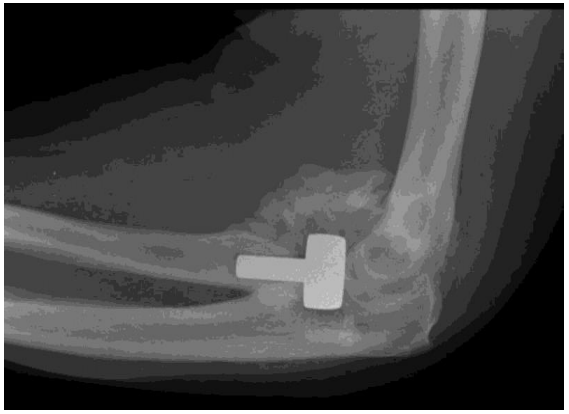
- Heterotopic ossification
- Graves orbitopathy (Linac)

SYMPTOMATIC FUNCTIONAL DISORDERS

- Heterotopic ossification (HO) is a pathological repair process, which is characterized by excessive bone formation in soft-tissue structure about joints after fractures and other traumatic events, including the most intended surgical procedures such as total hip arthroplasty,and other joint replacement procedures.
- In high-risk situations of hip joint replacement, the use of either pre-operative or postoperative RT of the hip region provides an effective prophylactic means for reducing the risk of HO.
- To achieve an optimal outcome, RT should be applied during a radiosensitive period of the bony precursor cells.

Heterotopic ossification

- Heterotopic ossification of the coxofemoral joint occurs 3 to 8 weeks after implantation of the hip prothesis.
- Radiation therapy is applied in the perioperative period (within 24 to 48 h), in order to prevent ossification.
- The treatment is super-voltage radiation 7 to 8 Gy / 1 fr. or 8 to 12 Gy in 2 to 3 fractions
- 8682 patients treated with RT for the prevention of HO were evaluated and analysed.
- High rate of prevention of HO after hip joint replacement with up to 90% by means of pre- or post-operative RT.



PAINFUL DEGENERATIVE DISORDERS

- Painful arthrosis of the knee joint
- Painful arthrosis of the hip joint
- Painful arthrosis of the hand and finger joints
- Painful shoulder syndrome
- Painful elbow syndrome
- Painful trochanteric bursitis
- Painful plantar fasciitis

- *CA ++ JONA DESTRUCTION IN CALCIFICATE AS A CONSEQUENCES OF RADIATION*

Painful heel syndroma (Plantar fasciitis)

- Painful heel syndroma (achilodinia and calcaneodinia) arises as exostosis that occurs at the attachments of the Achilles tendon and plantar fascia on calcaneus.
- Radiation has an antidoloric effect in 70 to 80% of patients.

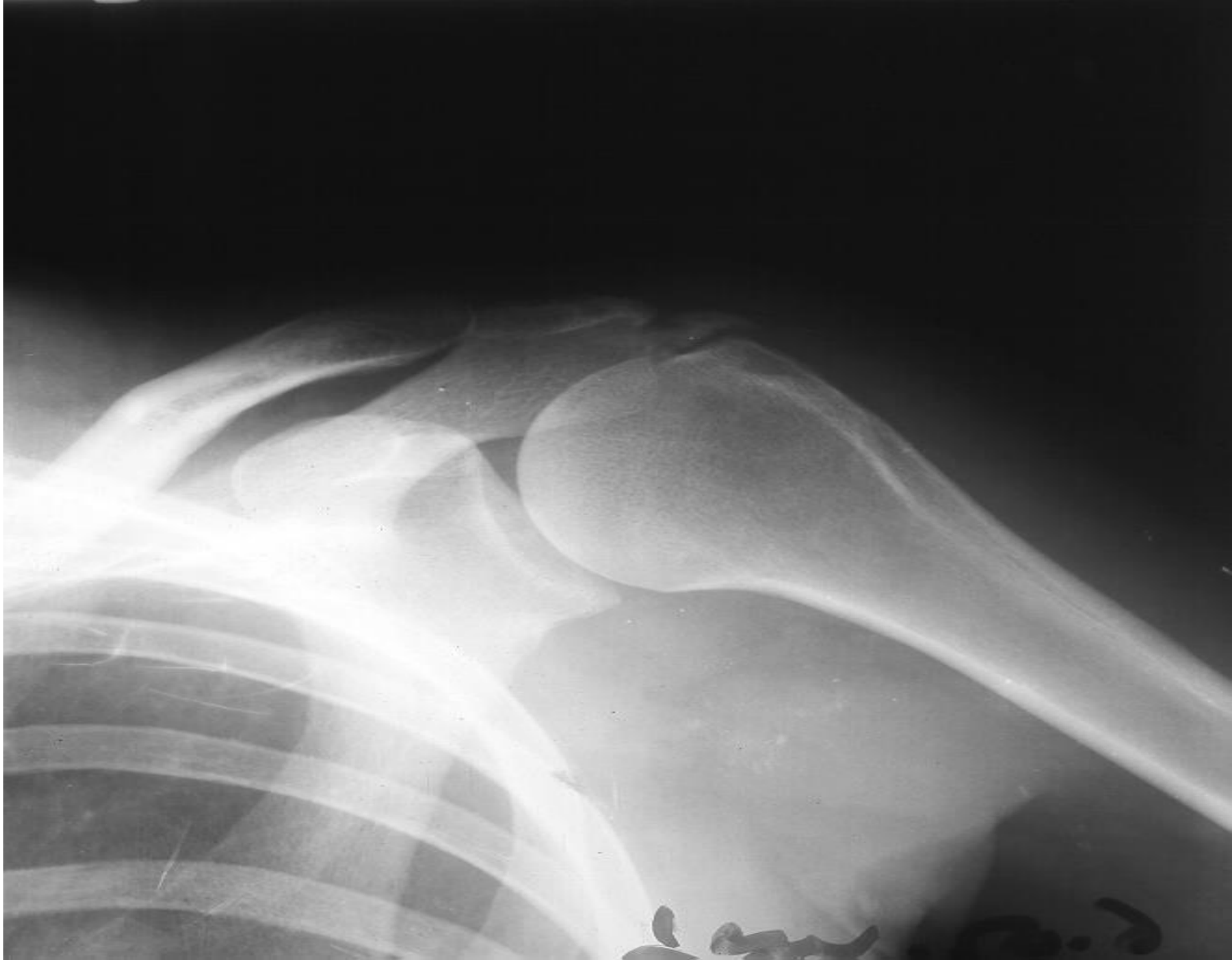
- Radiation is carried out by kV or MV x rays, through one direct plantar or dorsal field or through two lateral opposite air fields.
- The irradiation field includes calcaneus with insertions of the Achilles tendon and plantar fascia.
- A dose of 3 to 6 Gy in 6 fractions is applied to a certain depth over two weeks.
- Treatment can be repeated after two to three months to a total TD of 12Gy

PERITENDINITIS HUMEROSCAPULARIS AND EPICONDYLOPATHIA HUMERUS

- Peritendinitis humeroscapularis (PHS) and epicondylopathia humerus (EPH): are degenerative disorders of the tendons that attach to the bones of the shoulder and elbow joint.
- EPH is manifested by pain in the lateral epicondyle (tennis elbow) or medial epicondyle (golf elbow), while shoulder pain and limited mobility are the main symptoms in PHS.
- Radiation dose of 3 to 6 Gy in 6 fractions over two weeks. Treatment can be repeated after two to three months to a total TD of 12Gy

PERIARTHRITIS HUMEROSCAPULARIS

- Shoulder pain and limited mobility are major symptoms of PHS
- Degenerative, inflammatory disease of the periarticular soft tissue (enthesitis, tenosynovitis, bursitis, adhesive capsulitis)
- Lymphocytic infiltration and hyperplasia
- Formation of calcifications



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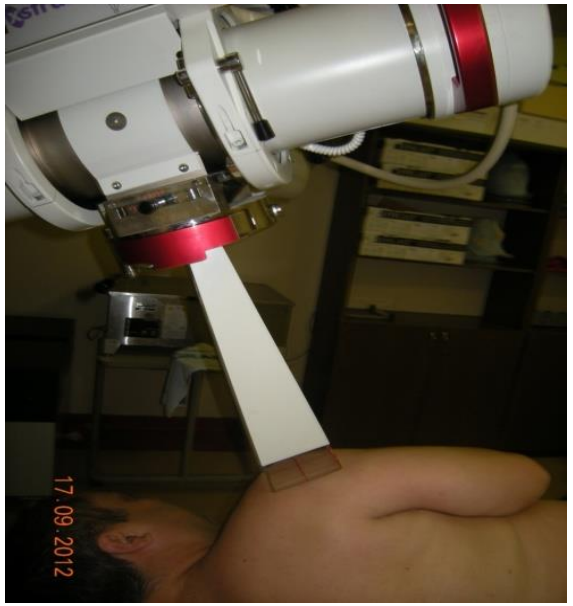
- A dose of 3 to 6 Gy in 6 fractions is applied over one direct or two opposite fields in the area of the painful joint, to the desired depth, kV or MV photons, for 6 weeks. Treatment can be repeated after two to three months to a total TD of 12Gy
- Radiation can similarly be used to achieve antidolorous and anti-inflammatory effects in arthrosis of the knee, hip and spine.



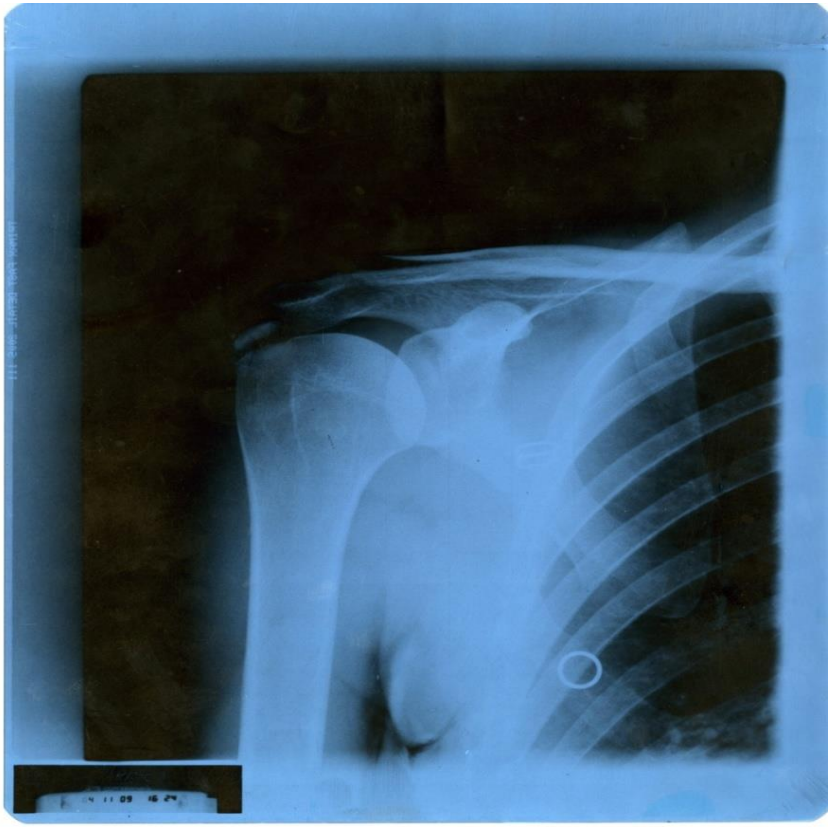
PHS

Before RT

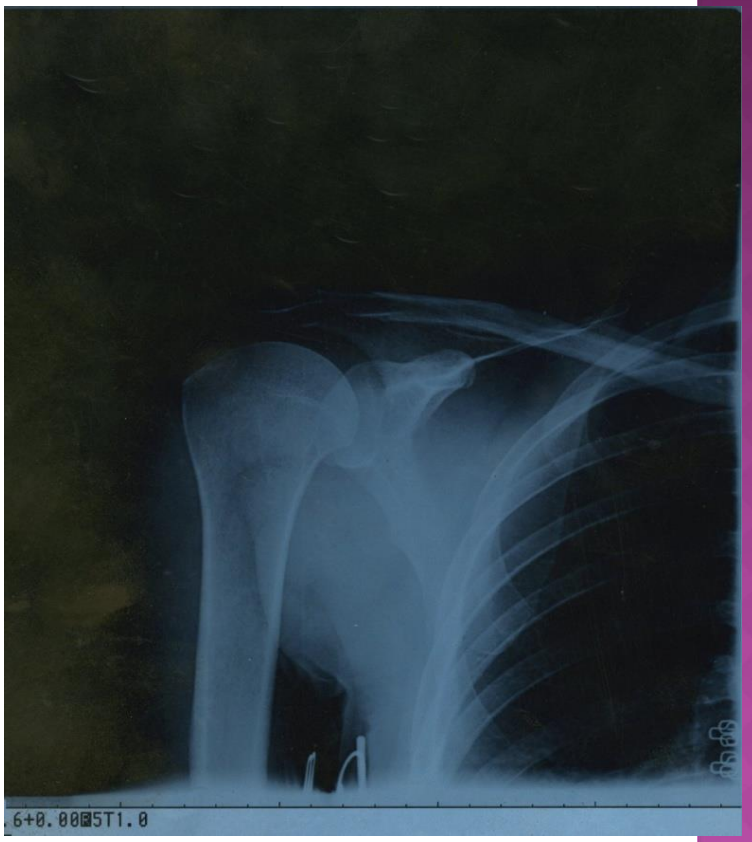
After RT

PHS

Before RT



After RT



- Epicondylopathia of humerus (EPH) is a degenerative disorder of the tendons that attach to the bones of the elbow joint.
- EPH is manifested by pain in the area of the lateral epicondyle (tennis elbow) or medial epicondyle (golf elbow).

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Table 4. Recommendations for single and total doses

Specific disease	Single dose (Gy)	Total dose (Gy)
Painful arthrosis of the knee joint	0.5–1.0	3.0–6.0
Painful arthrosis of the hip joint	0.5–1.0	3.0–6.0
Painful arthrosis of the hand and finger joints	0.5–1.0	3.0–6.0
Painful shoulder syndrome	0.5–1.0	3.0–6.0
Painful elbow syndrome	0.5–1.0	3.0–6.0
Painful trochanteric bursitis	0.5–1.0	3.0–6.0
Painful plantar fasciitis	0.5–1.0	3.0–6.0
Morbus Dupuytren	3.0	15.0 (repeat after 12 weeks)
Morbus Ledderhose	3.0	15.0 (repeat after 12 weeks)
Keloids	3.0	12.0
Peyronie's disease	2.0–3.0	10.0–20.0
Desmoid tumours	1.8–2.0	50.0–65.0
Symptomatic vertebral haemangiomas	1.8–2.0	34.0–36.0
Pigmented villonodular synovitis	1.8–2.0	36.0–40.0
Gorham Stout syndrome	1.8–2.0	36.0–45.0
Heterotopic ossification (pre-operative)	7.0	7.0
Heterotopic ossification (post-operative)	3.5	17.5
Graves orbitopathy (early inflammatory phase)	0.3–2.0	2.4–16.0
Graves orbitopathy (advanced inflammatory phase)	2.0	16.0–20.0

SEEGENSCHMIEDT MH.ET AL. RADIOTHERAPY FOR NON-MALIGNANT DISORDERS: STATE OF THE ART AND UPDATE OF THE EVIDENCE-BASED PRACTICE GUIDELINES. BR J RADIOL 2015

WHY RADIOTHERAPY IN BENIGN DISEASES?

- Local control of progressive disease
- Pain reduction and distress syndrome
- Preservation - preservation of organ function
- Prevention of possible complications of an existing disease
- Avoiding other much more aggressive and mutant forms of treatment
- Preserving good cosmetic effect and quality of life

WHEN APPLIED?

- When other treatments have no results
- When other forms of treatment have serious consequences on the quality of life, ie. when sequelae of treatment are serious
- It is never the first choice of treatment but it is acceptable and defined
- Widely accepted for non-malignant diseases in many countries

CONCLUSION

- Benign disease radiotherapy is gaining in importance, especially where other treatments have not led to an improvement in the patients' condition.
- When radiotherapy is successfully applied and the symptoms of the disease are significantly milder or completely gone, the quality of life outweighs the minimal potential risk associated with the use of ionizing radiation.

Thank you for atention