

Department of Physical Medicine and Rehabilitation

शरीरिक चिकित्सा एवं पुनर्वास विभाग

All India Institute of Medical Sciences, Raipur

अखिल भारतीय आयुर्विज्ञान संस्थान, रायपुर (छत्तीसगढ़)



आरोग्यम् सुख सम्पदा



**ILLUSTRATED HANDBOOK  
ON POST COVID-19  
PULMONARY REHABILITATION**



Spring in Kulu: Nicholas Roerich

"Start by doing what's necessary; then do what's possible; and suddenly you are doing the impossible." -Francis of Assisi

**ILLUSTRATED HANDBOOK ON POST COVID-19 PULMONARY REHABILITATION**  
**:DEPARTMENT OF PMR**  
**AIIMS, RAIPUR (CHHATTISGARH)**

**PREFACE:**

The year 2020 brought an pandemic of unprecedented proportion into our doorsteps and created many 'new normals'. The deadly virus wreaked havok on our economy and our health. We are even unsure about its longterm complications especially on our pulmonary system.

Managing post covid pulmonary fibrosis especially in those patients who managed to recover after mechanical or non invasive ventilation can be an arduous process.

This handbook deals with such patients and their management through a novel graphics comics approach.

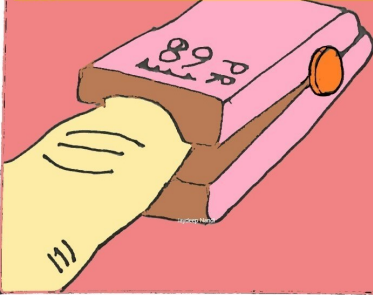
Some topics that have been dealt here include:

- Dyspnea and positions for relief.
- Few helpful breathing retraining techniques.
- A useful self airway secretion management strategy
- Types and methods of Inspiratory muscle strengthening.
- Home based reconditioning.

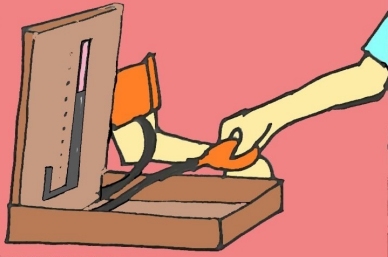


**DYSPNEA MONITORING:**

(1) INTOLERANCE TO EXERCISE CAN MANIFEST WITH DYSPNEA OR INCREASE IN HR 20-30 BPM ABOVE RESTING LEVEL



SBP INCREASE 20-30 MM HG ABOVE RESTING LEVEL OR DECREASE MORE THAN 10 MM HG SHOULD ALSO BE TREATED CAUTIOUSLY



OBSERVE CAUTION IF OXYGEN SATURATION DROPS BELOW PRESCRIBED LIMIT OR 90%



LIKewise, SHORTNESS OF BREATH AFTER DOING EXERCISE OR INTOLERABLY INCREASED RESPIRATORY RATE CAN BE FEATURES OF ABNORMAL RESPONSE TO EXERCISE (PER 1 MET LEVEL)



OTHER FEATURES INCLUDE CHEST PAIN, INCREASED PERSPIRATION, COLOUR CHANGE, AGITATION, NON VERBAL SIGNS OF PAIN



AS WELL AS ECG CHANGES (LIKE PAROXYSMAL ATRIAL TACHYCARDIA) SUGGESTS OVER EXERTION OR ABNORMAL BODILY RESPONSE TO EXERCISE



**POSITIONING FOR DYSPNEA RELIEF:**

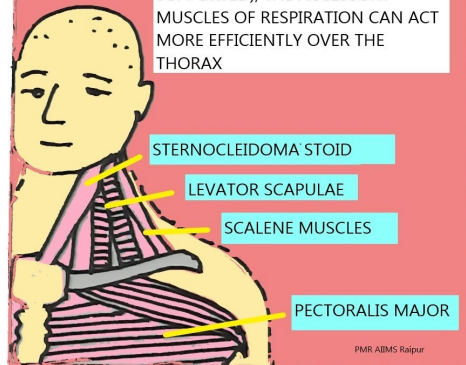
(1) THE ARM SHOULD BE SUPPORTED ON A WHEELCHAIR



OR RECLINE ON A BED KEEPING THE ARMS RELAXED ON YOUR SIDE



WITH THIS POSITIONING (OF ARMS SUPPORTED), THE ACCESSORY MUSCLES OF RESPIRATION CAN ACT MORE EFFICIENTLY OVER THE THORAX



(2) SIMULTANEOUSLY LEANING FORWARD WILL ALSO HELP



IT WILL PUSH THE DIAPHRAGM UP IN A LENGTHENED POSITION



SIMPLE SUPPORTED STANDING IN SLIGHTLY STOOPED POSTURE IS ABLE TO INCREASE STRENGTH OF DIAPHRAGMATIC CONTRACTION



**BREATHING RETRAINING:**

(1) **PURSED LIP BREATHING (PLB)** DECREASE AIRWAY COLLAPSE DURING EXPIRATION AND THUS RELIEVE DYSPNEA ASSOCIATED WITH COPD ETC.



INHALE THROUGH THE NOSE FOR SEVERAL SECONDS WITH THE MOUTH CLOSED

THEN, EXHALE SLOWLY OVER 4-6 SECONDS THROUGH LIPS HELD IN A WHISTLING POSITION



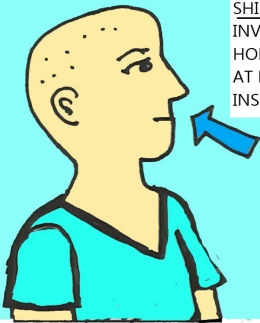
YOU MAY BEND FORWARD SLIGHTLY AND USE ABDOMINAL MUSCLE CONTRACTION DURING PLB



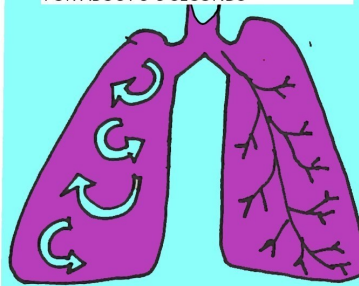
USUALLY DONE @10 BREATHS AT A TIME WITH 5 SECONDS REST PERIOD AFTER EACH BREATH

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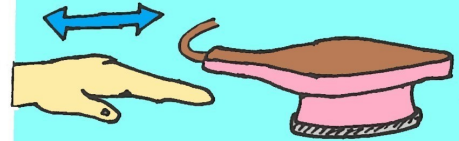
(2) **INSPIRATORY HOLD TECHNIQUE OR AIR SHIFTING TECHNIQUE:** INVOLVES PROLONGED HOLDING OF THE BREATH AT MAXIMUM INSPIRATION



THE BREATH HOLDING SHOULD BE WITHOUT VALSALVA MANEUVER AND FOR ABOUT 3-5 SECONDS



THIS SIMPLE METHOD OF IMPROVING AIR FLOW INTO POORLY VENTILATED LUNG ZONES CAN BE USED ALONG WITH CHEST WALL VIBRATION (VIA HAND OR VIBRATOR DEVICES)



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(3) **PACED BREATHING** IS DEFINED AS VOLITIONAL CO-ORDINATION OF BREATHING DURING ACTIVITY

DURING RHYTHMIC MOTION, BREATHING CAN BE EASILY CO-ORDINATED WITH THE RHYTHM OF THE ACTIVITY



DURING NON RHYTHMIC ACTIVITY, USUALLY YOU SHOULD 'BREATHE IN' AT THE BEGINNING OF THE ACTIVITY AND 'OUT' DURING THE ACTIVITY



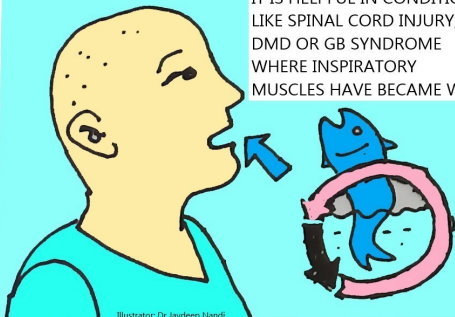
**PACED BREATHING TECHNIQUE** CAN BE COMBINED WITH PURSED LIP BREATHING OR DIAPHRAGMATIC BREATHING



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(4) **GLOSSOPHARYNGEAL BREATHING (GPB)** USES THE CHIEF TONGUE-THROAT MUSCLES TO SUCCESSIVELY INTRODUCE SMALL AMOUNTS OF AIR INTO THE LUNGS

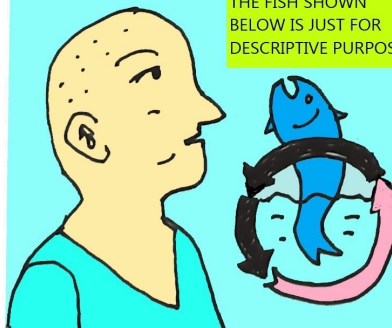
IT IS HELPFUL IN CONDITIONS LIKE SPINAL CORD INJURY, DMD OR GB SYNDROME WHERE INSPIRATORY MUSCLES HAVE BECOME WEAK



Illustrator: Dr. Jaydeep Handi

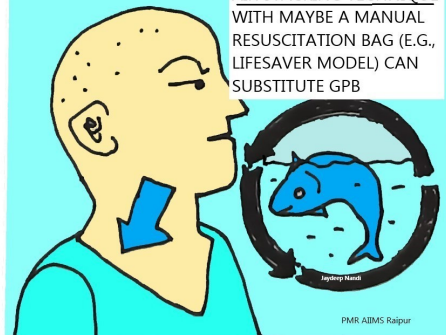
TAKE IN SMALL GULPS OF AIR (6-8 GULPS OF 60-100 ML EACH) WITHOUT EXPIRATION

THE FISH SHOWN BELOW IS JUST FOR DESCRIPTIVE PURPOSE



AFTER ATTAINING MAXIMUM TOLERABLE VOLUME, THE STACKED AIR IS PROJECTED PAST GLOTTIS INTO THE LUNGS

**AIR STACKING TECHNIQUE** WITH MAYBE A MANUAL RESUSCITATION BAG (E.G., LIFESAVER MODEL) CAN SUBSTITUTE GPB



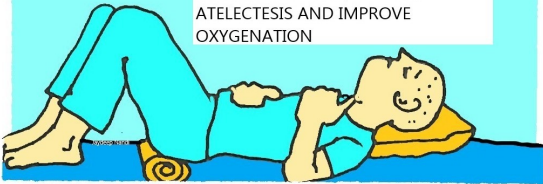
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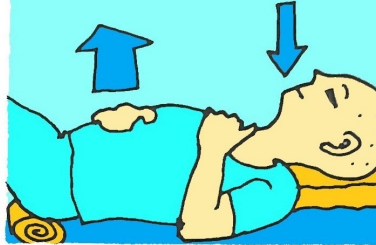
**BREATHING RETRAINING:**

(5) **DIAPHRAGMATIC BREATHING** INVOLVES FACILITATED OUTWARD MOTION OF ABDOMINAL WALL WHILE REDUCING UPPER RIB CAGE MOTION DURING INSPIRATION

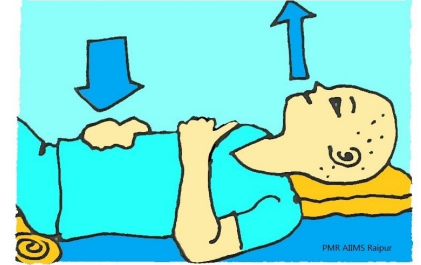
ALMOST UNIVERSALLY EMPLOYED TO MANAGE DYSPNEA, DECREASE ATELECTESIS AND IMPROVE OXYGENATION



FOR DIAPHRAGMATIC BREATHING (DB) YOU CAN START IN SUPINE POSITION, WITH A TOWEL ROLL AT ISCHIAL TUBEROSITIES TO IMPROVE PELVIC TILT

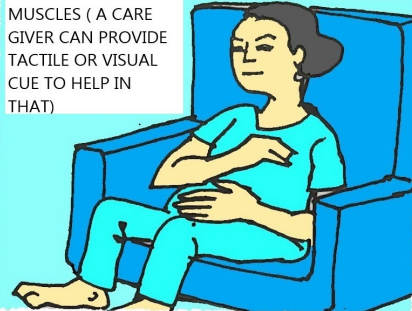


BREATHE DEEPLY THROUGH NOSE DISTENDING THE ABDOMEN, WHILE KEEPING THE CHEST WALL STATIONARY. SIMILARLY EXHALATION SHOULD FLATTEN THE BELLY AGAIN



DURING DB, RELAX THE ACCESSORY BREATHING MUSCLES (A CARE GIVER CAN PROVIDE TACTILE OR VISUAL CUE TO HELP IN THAT)

LATER IT SHOULD BE PRACTISED IN SEATING POSITION



THEN STANDING

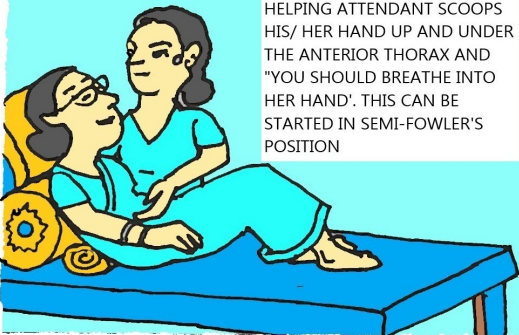


AND FINALLY DURING ACTIVITY

DESPITE ITS WIDESPREAD USE IN COPD, AMERICAN THORACIC SOCIETY GUIDELINE 1999 HAVE CAUTIONED AGAINST CHANCE OF CHEST ASYNCHRONY



(6) **MANUAL FACILITATION TO DB VIA SCOOP TECHNIQUE:** A HELPING ATTENDANT SCOOPS HIS/ HER HAND UP AND UNDER THE ANTERIOR THORAX AND "YOU SHOULD BREATHE INTO HER HAND". THIS CAN BE STARTED IN SEMI-FOWLER'S POSITION



OR MAYBE USED IN SIDE LYING POSITION



AS YOU IMPROVE ON YOUR DIAPHRAGMATIC BREATHING TECHNIQUE, THE HELPER CAN REMOVE HER HAND



(7) **MANUAL FACILITATION OF DB VIA UPPER CHEST INHIBITING TECHNIQUE:** HERE THE HELPER FIRST ASSESSES YOUR CHEST MOVEMENTS OVER FEW RESPIRATORY CYCLES TO GET AN IDEA



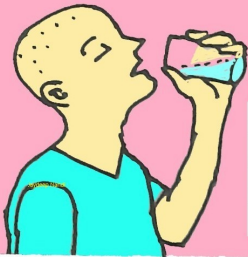
AFTER THAT, DURING 'BREATHING IN' SHE DOES NOT MOVE HER HAND POSITION (IN YOUR UPPER CHEST) THUS RESISTING EXPANSION



WHEN YOU HAVE MASTERED THE DB OR LOWER CHEST BREATHING PATTERN, SHE CAN REMOVE HER UPPER HAND BUT PREFERABLY KEEP GIVING SCOOP FACILITATION



**AIRWAY SECRETION MANAGEMENT:**  
**(1) AUTOGENIC DRAINAGE**

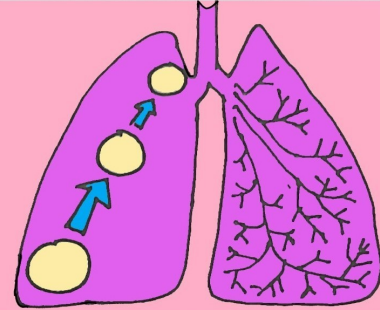


AT FIRST YOU SHOULD HYDRATE YOURSELF

THEN CLEAR YOUR NOSTRILS BY DEEPLY BLOWING OVER A TISSUE

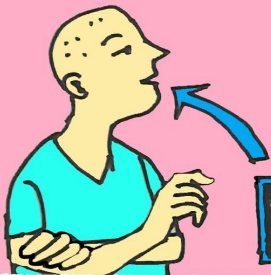


THE TECHNIQUE DESCRIBED IS A WAY OF SELF MOBILIZATION OF SECRETIONS FROM DISTAL TO PROXIMAL AIRWAYS



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START 'BREATHING IN' WITH A LOW TIDAL VOLUME



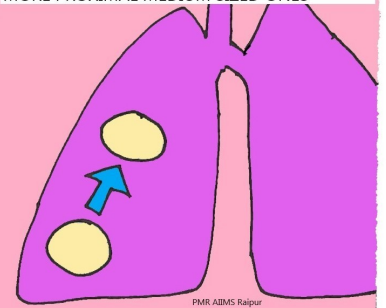
THE SPIROMETER SHOWN BELOW IS JUST FOR DESCRIPTIVE PURPOSE



BUT 'BREATHE OUT' AS DEEPLY AS POSSIBLE

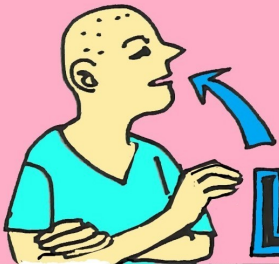


YOU CAN FEEL THAT YOUR SECRETIONS HAVE MOVED FROM DISTAL SMALLER AIRWAYS TO MORE PROXIMAL MEDIUM SIZED ONES

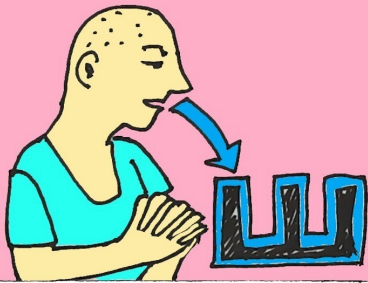


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THE SUBSEQUENT 'BREATHING IN' SHOULD BE OF MEDIUM TIDAL VOLUME



BUT 'BREATHING OUT' WILL CONTINUE TO BE DEEP AND MAXIMUM



FINALLY THE INHALATION WOULD BE DEEP AND MAXIMUM



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WHILE EXHALATION WILL BE FULL AS BEFORE, SO THAT SECRETIONS ARE FINALLY MOBILIZED TO THE PROXIMAL LARGE AIRWAYS



FINALLY COUGH TWO TIMES IN SHORT EXPULSIVE BURSTS TO EXPEL THE SECRETIONS IN TO THE THROAT



SIMULTANEOUS CONTRACTION OF ABDOMINAL MUSCLES ALONG WITH HUFFING (COUGHING WITH GLOTTIS OPEN) WILL BE BENEFICIAL IN THIS STAGE



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**INSPIRATORY RESISTIVE TRAINING :**  
 (1) **INSPIRATORY MUSCLE TRAINER (IMT)** WORKS ON THE PRINCIPLE OF INSPIRATORY RESISTIVE LOADING.

IMT IS HELPFUL AFTER WEANING FROM VENTILATOR OR IN COPD PATIENTS



IMT EXERCISERS ARE EASILY AVAILABLE ONLINE. BEGIN WITH WASHING YOUR HANDS PROPERLY



APPLY NASAL CLIPS



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INHALE THROUGH INSPIRATORY ORIFICE OF GRADUALLY DECREASING DIAMETER

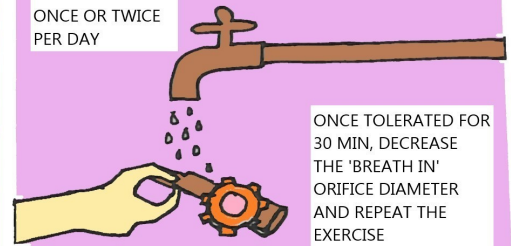
THE KNOB IS PROVIDED WITH RESISTANCE MARKERS '1-2-3-4-5' TO SET THE DIAMETER



BUT IMT ALLOWS BREATHING OUT WITHOUT RESISTANCE



TRY 10-20 BREATHS/MIN FOR 15-30 MIN ONCE OR TWICE PER DAY



ONCE TOLERATED FOR 30 MIN, DECREASE THE 'BREATH IN' ORIFICE DIAMETER AND REPEAT THE EXERCISE

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(2) THE POPULAR INCENTIVE SPIROMETER WORKS ON THE PRINCIPLE OF INSPIRATORY THRESHOLD LOADING



IT BUILDS UP VENTILATORY STRENGTH AND ENDURANCE (NOT PULMONARY CAPACITY) IN SAME PATIENT GROUPS AS ABOVE

KEEP THE DEVICE AT MOUTH LEVEL AND SEAL THE MOUTH PIECE PROPERLY



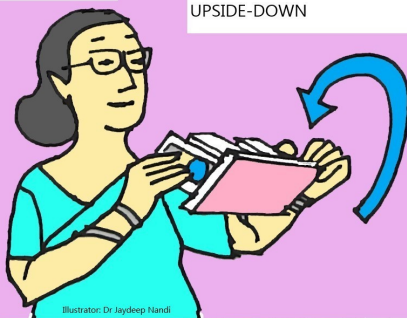
TRY TO LIFT ALL THE THREE BALLS BY 'BREATHING IN' AND SUSTAIN THE POSITION FOR 3-5 SECONDS



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DONE @ 20 BREATHS/MIN FOR 15-20 MINUTES TWICE DAILY

IF NECESSARY, EXPIRATORY TRAINING IS ALSO POSSIBLE BY TURNING THE DEVICE UPSIDE-DOWN

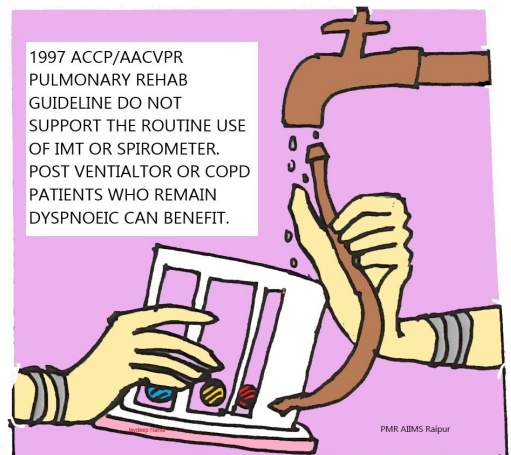


Illustrator: Dr. Jaydeep Nandi

BY 'BREATHING OUT' THE WEIGHTED BALLS MAY BE LIFTED AND RAISING UP A SINGLE BALL IS SUFFICIENT



1997 ACCP/AACVPR PULMONARY REHAB GUIDELINE DO NOT SUPPORT THE ROUTINE USE OF IMT OR SPIROMETER. POST VENTILATOR OR COPD PATIENTS WHO REMAIN DYSPNOEIC CAN BENEFIT.



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**EXERCISE FOR RECONDITIONING:** (1) STATIONARY MARCHING IS GOOD SUBSTITUTE FOR STATIONARY CYCLING



USUALLY DONE FOR 4 MINUTES FOLLOWED BY 1 MINUTE REST



IN CASE OF BALANCE IMPAIRMENT YOU CAN TAKE SUPPORT OF A SOFA AND LIFT THE KNEES ONE AT A TIME



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(2) STAIR CLIMBING CAN BE DONE AT HOME SETTINGS



CLIMB ONE FLIGHT OF STAIRS AND COME BACKWARDS TO GROUND. SAME SHOULD BE REPEATED FOR TWO STAIRS AND THEN THREE STAIRS



USUALLY DONE FOR 4 MINUTES FOLLOWED BY 1 MINUTE REST

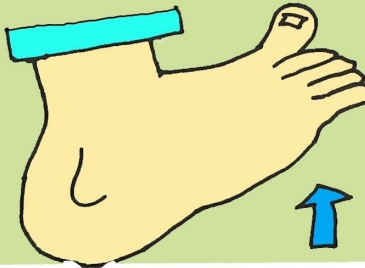


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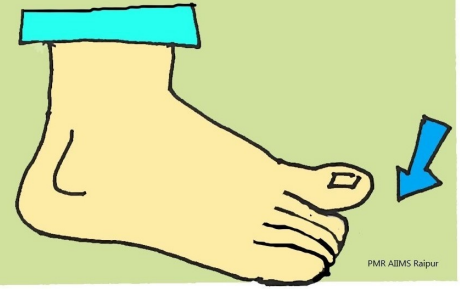
(3) SITTING ANKLE PUMPS ARE GOOD FOR OFFICE SETTINGS



SMOOTH 'TO AND FRO' ANKLE MOVEMENTS CAN BE PRACTISED WHILE SEATING IN A CHAIR



REPEAT THE BRISK ANKLE MOVEMENTS FOR 4 MINUTES FOLLOWED BY 1 MINUTE REST



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(4) VARIOUS OTHER SIMPLE RECONDITIONING EXERCISES CAN BE PRACTISED LIKE SIT TO STAND



LIFTING YOUR KNEE TOWARDS THE CEILING WHILE COMFORTABLY SEATED IN CHAIR CAN ALSO HELP



CROSSING OVER AN OBSTACLE (LIKE STACK OF BOOKS) WILL ADDITIONALLY IMPROVE BALANCE



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