Precision and Comfort Apple probe project

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New probes' family: Ergonomic Innovation

OBJECTIVE:

A new ergonomic approach that will maximize the comfort of the grip with the objective to eliminate tensions of the muscles, tendons, and nerves that are typical of the traditional **"pen" grip**.

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Biomedical Engineering Design 300/200

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December 8, 2004

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ABSTRACT

Ergonomic Ultrasound Probe

Uses of ultrasound

Ultrasound examination is a relatively inexpensive, simple, non-invasive and reliable diagnostic medical procedure that can be used to examine many parts of the body. Ultrasounds are regularly used in clinics, hospitals, private practice physician offices, public health facilities, labs, and other medical settings. Several areas of the body that are routinely examined are the abdomen, breasts, female reproductive organs, prostate, heart, eye, and blood vessels. . Ultrasounds are useful for examining soft tissue and fluid filled organs such as the bladder, which do not show up clearly on an xray.

Sonographers in obstetrics use ultrasound to examine the heart, brain anatomy, deformities, spine, heartbeat, and location of the fetus. Ultrasound can be used to find tumors or deformities, carotid arteries in the vascular system, cysts in the breasts, tears in tendons, eye deformities, and guide a needle during a biopsy.

Occupational Hazards of Sonography

Roughly 80% of sonographers report that they have some sort of musculoskeletal complaint of the hand and wrist, and neck and back in conjunction with use of the probe and specific to the limb used to examine a patient. The most commonly diagnosed musculoskeletal injuries are fibromyalgia, myofascial pain, rotator cuff tendonitis, bursitis, and carpal tunnel syndrome. The sonographers suffer from repetitive strain injury, which are small repetitive stresses that accumulate over time. The repetitive strain injury symptoms increase with the continuation of the repetitive motion.

Sonographers can perform 100 or more scans per month, with an average exam time of 25 minutes per scanning session.

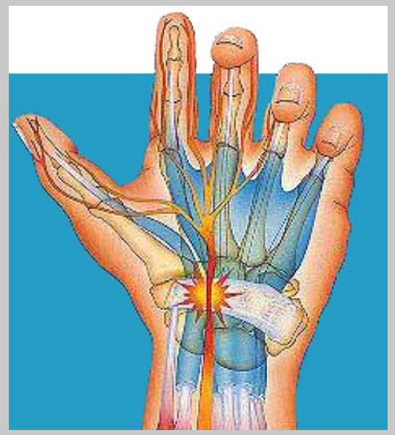

Figure 2: This diagram depicts carpel tunnel syndrome by highlighting the ligaments and nerves being affected.

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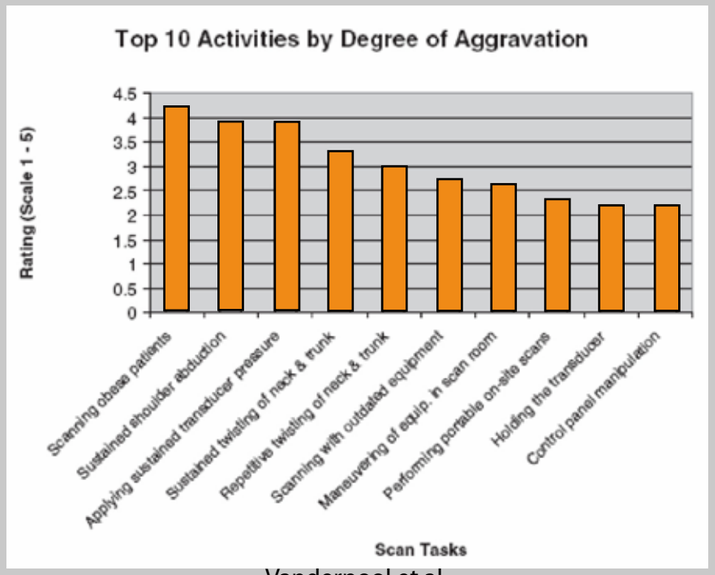
TIn a survey done by Vanderpool et al., 63% of all respondents had had symptoms of carpal tunnel syndrome (Figure 2) at some point in their careers]. **Symptoms included: tingling, numbness, shooting sensations, and burning pain in the thumb or index and middle fingers during work or non-working times, changes in the muscle bulk of the palm of the hand, and clumsy fingers.** They found that the amount of **pressure used to hold a transducer could be linked to symptoms of carpal tunnel syndrome**. Using a 5-point scale, sonographers were asked to report activities that aggravated musculoskeletal symptoms. The activities that were rated the highest were scanning obese patients, applying sustained shoulder abduction and applying a continual pressure with the transducer.

Many of the workers reporting injury stated that they had to use sick time, vacation time, and workers' compensation benefits to deal with the time lost due to injury. Sick time and workers' compensation costs for thirteen work sites using ultrasound imaging reached levels upwards of $180,000 because of injuries during 2001-2002. [...]



Vanderpool et al.

While manufacturers have made many ergonomic modifications to the ultrasound machines as a whole, the client wanted a design that focused on the hand-held transducer. **The design needs to address the pinching and pushing** associated with transducer use by sonographers. The design would need to alleviate the stress put on the sonographer when they are required to grasp the probe and apply pressure with it onto the patient. The main goal is to improve the wellbeing and safety of the sonographer, especially their wrists,elbows, and shoulders.

Ultrasound imaging relies on very small adjustments of the transducer head during exams for quality imaging; therefore a new design must give the sonographer a good amount of fine movement ability. In addition, good sonography is a learned skill that technicians work at to become proficient, so drastically changing probing procedures should be avoided. A design that can assist for long periods of time would also be ideal because of the large variation in exam times (from ~30 minutes up to ~8 hours).

Sometimes the probe must be held in only one spot with constant pressure for a long 9 exam, and this can be very taxing on the sonographer. Regular exams are also getting longer as newer scanning technologies are being utilized, and sonographers are only being put under a bigger burden.

ABSTRACT

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ERGONOMIC EXAMINATION

Relax position

Use position

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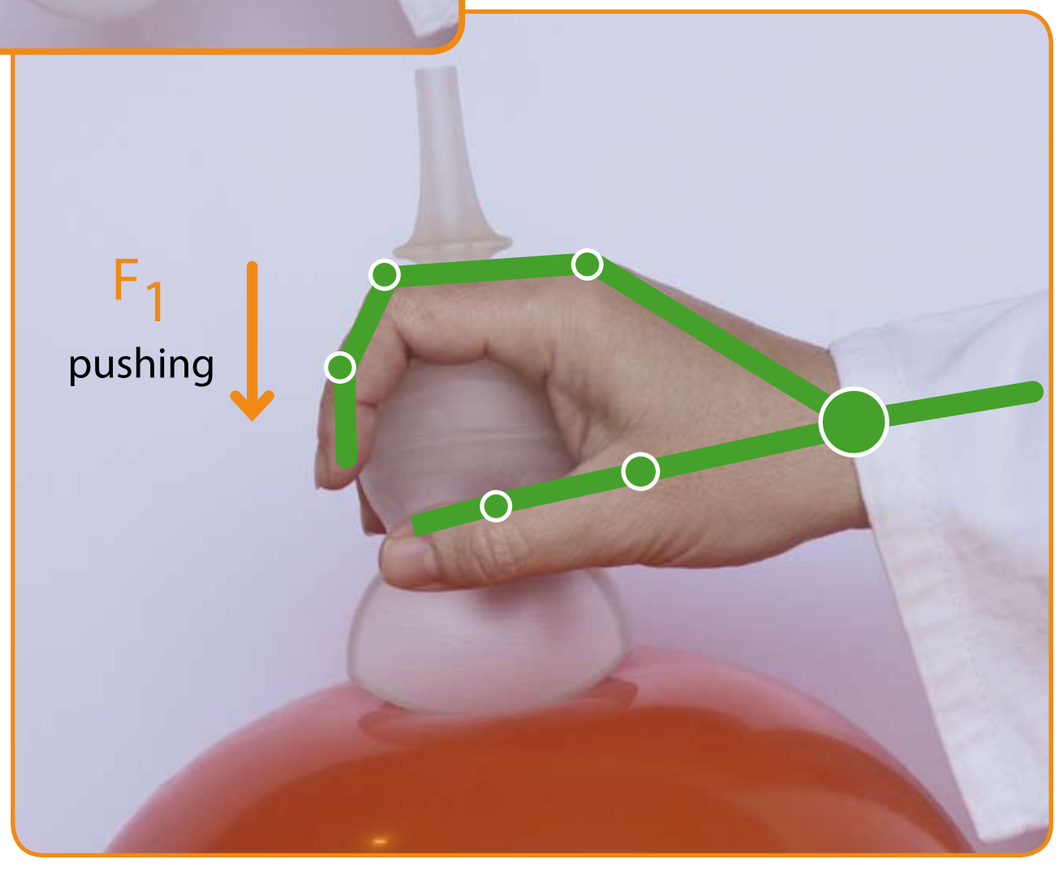
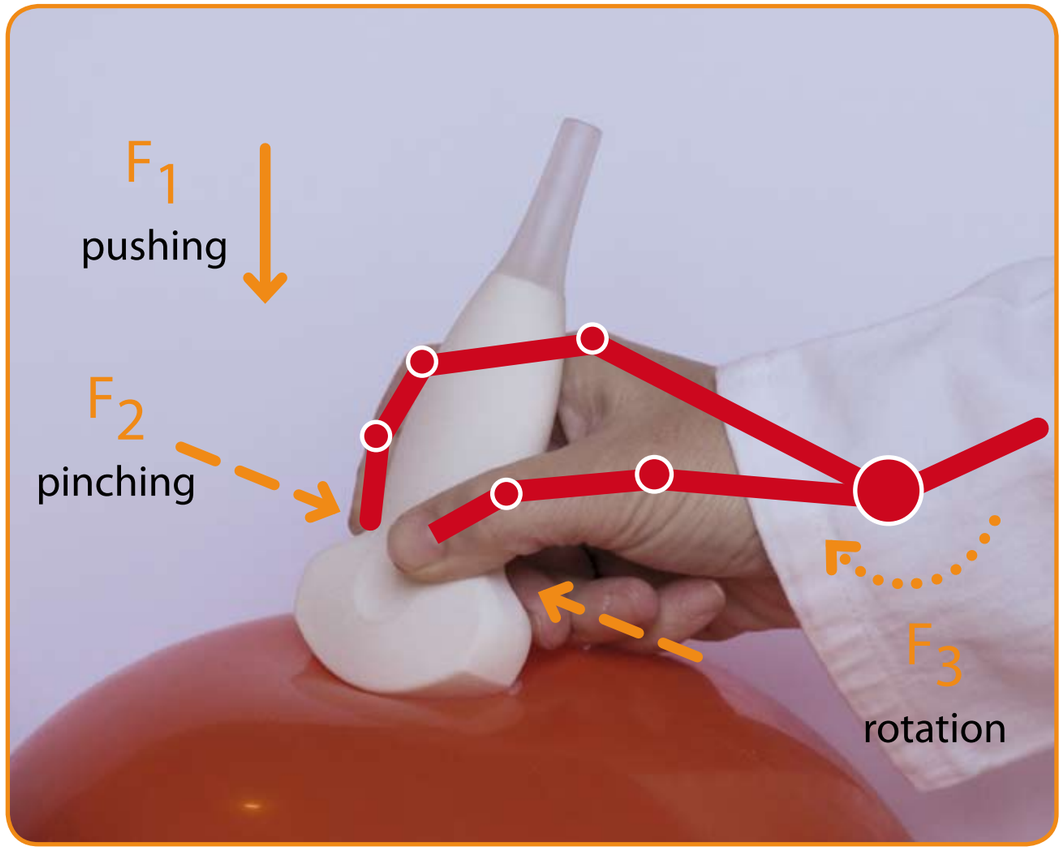
Relax position

the hand is not obliged to squeeze the probe (keeping a constant tension in the fingers).



Use position



Use position

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no Relax position

The muscles, tendons and nerves remain in constant tension, caused by two necessary movements to keep the probe in the hand Pinching and to scan Pushing.

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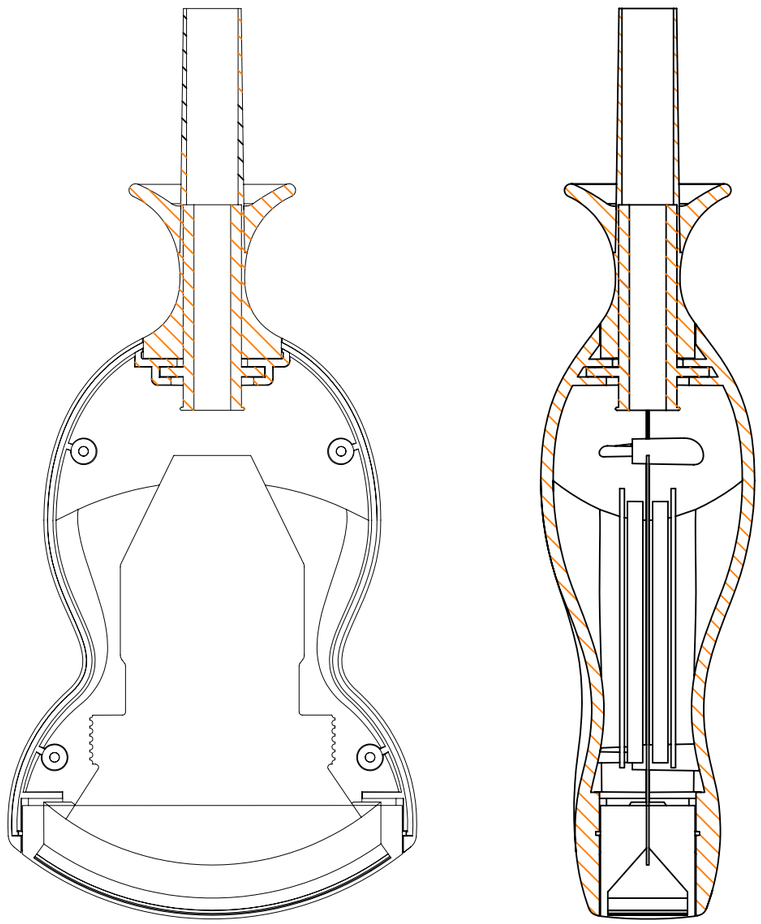
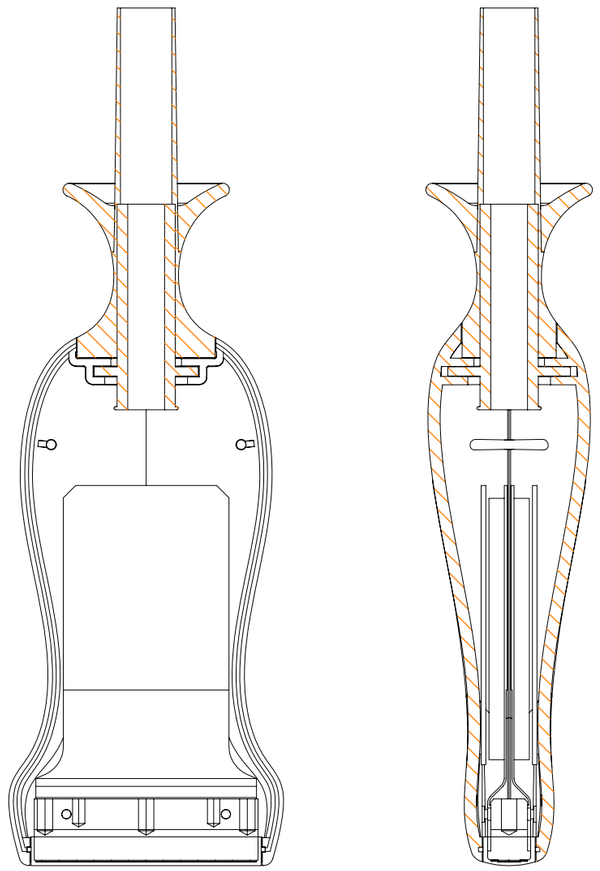
CONVEX R50



LINEAR L37



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CONVEX probe

relaxed grip:
allows the hand to relax

working grip:
horizontal scanning

working grip:
vertical scanning

The new ergonomic approach does not exclude the traditional “pen” grip. It only gives more choice to the sonographer.

working grip:
traditional pen grip

working grip:
traditional pen grip

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LINEAR probe

relaxed grip:
allows the hand to relax

working grip:
horizontal scanning

working grip:
vertical scanning

The new ergonomic approach does not exclude the traditional “pen” grip. The LINEAR probes should be advantageous while performing vascular exams with standing patients.

working grip:
traditional pen grip

working grip:
traditional pen grip