In human otosclerosis, focal pathological bone remodeling occurs inside the normally anti-resorptive perilabyrinthine domain of the bony otic capsule. Otosclerosis causes hearing loss in 0.2-0.5% of the population by ankylosis of the footplate. The disease cannot be predicted, avoided or medically reversed as the pathogenesis remains unknown. Previously genetic research has failed to identify a specific otosclerosis-gene and earlier theories of virus infections, autoimmune or association to generalized bone diseases have been unable to explain why otosclerosis only occurs in the bony otic capsule while the rest of the skeleton remains completely normal.

Hearing loss and tinnitus are the main symptoms of otosclerosis. Little is known about the cause of tinnitus and the factors influencing the effect of surgery on it. The principle aim of stapes surgery is to restore hearing but some patients also report reduction in the severity of tinnitus and even complete cessation of it.

The aim of our study was to assess the postoperative hearing results and the incidence of complications and compare them with the literature data.

Material and methods
We studied 178 patients with conductive hearing loss caused by otosclerosis that underwent stapedotomy with the use of CO2 laser at MMA Sofia for a period of 2 years. 104 (58.4%) were females and 74 (41.6%) were males.

Their ages were between 18 years and 64 years; the mean age was 34.6 years. All patients underwent pure tone audiogram in a standard soundproof room including air conduction and bone conduction before and 1 month after the stapes surgery, and the air-bone gap was calculated at the standard frequencies: 0.5, 1, 2, 4 kHz.

We used the following surgical technique: A selfretaining ear speculum was placed. Under the microscope a posterior tympanomeatal flap was created by the laser. A Smart piston prosthesis was placed and fitted on the long process of the incus by the laser. The vestibule was sealed with homogenic fat tissue. The tympano-mental flap was repositioned. The removal of the stapes superstructure was achieved by the laser. The hole in the foot-plate was created by the laser. A Smart piston prosthesis was placed and fitted on the long process of the incus by the laser.

The vestibule was sealed with homogenic fat tissue. The tympano-mental flap was repositioned, a silicone protector and an expandable external mepatus swab were placed.

Results
The duration of symptoms was between 1 and 12 years. The commonest were hearing loss (97.5%) and tinnitus (46.3%). There were no serious vestibular complaints. The symptoms were bilateral in the majority of the cases 141 (79.2%). The overall mean pre-operative air bone gap was 37.4 dB, and the overall mean post operative air bone gap was 9.6 dB. The air-bone gap was closed to within 10 dB in 172 cases (96.6%). No case of cochlear loss greater than 15 dB occurred. The incidence of complications and tinnitus was very low.

Discussion
Surgery is the most effective method of improving hearing in patients with otosclerosis. The level of improvement depends on the stage of the disease and the chosen surgical method. Both laser and classic techniques can be used successfully in stapes surgery without causing long-term damage to the inner ear. CO2 laser is used in stapes surgery due to the precise ablation of bony structure without significant inner ear damage.

Typical surgical complications are rare but can be persistent and include vertigo and sensorineural hearing loss up to complete single-sided deafness. The most common finding which necessitates stapes revision surgery is the necrosis of the long incus process with dislocation of the stapes piston. The removal of the stapes superstructure and perforation of the footplate are the critical steps of this surgical procedure.

With the introduction of laser-assisted techniques, the surgical safety has been improved compared to conventional techniques. KTP, argon, as well as diode, Er:YAG and CO2 lasers are used for stapedotomy. By using the CO2 laser in conjunction with a scanner system, the number of laser applications required for the perforation of the footplate has been markedly reduced. In contrast to other systems, a more reproducible perforation diameter of the stapes footplate is achieved with a laser equipped with a scanner. Complications such as uncontrolled leakage of perilymph, irradiation of inner ear structures or the occurrence of pressure waves with subsequent damage to the inner ear are reduced.

Stapedotomy is currently the preferred technique in the surgical treatment of otosclerosis. Furthermore, several modifications exist today in the design of the stapes prosthesis all over the world. The Smart piston- prosthesis remains one of the most popular devices in use today. Possibly because Teflon is well-tolerated and it does not react with the tissues in the middle ear. In this study, we found a significant closure of the air-bone gaps within and across the frequencies 0.5, 1, 2 and 4 kHz.

Conclusion
On the basis of the degree of postoperative hearing improvement, and the incidence of tinnitus and complications it can be concluded that the use of CO2 laser during stapedoplasty is an effective and safe method, justifying the high cost of the equipment.