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DENTAL MULTI-PURPOSE SLOWSPEED HANDPIECES

Test and Evaluation

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USAF SCHOOL OF AEROSPACE MEDICINE
Aerospace Medical Division (AFSC)
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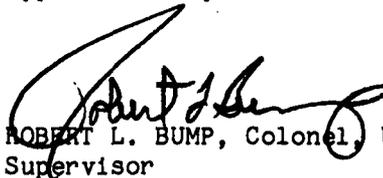
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This report has been reviewed and is approved for publication.



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DENTAL MULTI-PURPOSE SLOWSPEED HANDPIECES

Test and Evaluation

INTRODUCTION

Presently there are no nationally or internationally accepted design standards, specifications, or performance characteristics for dental multi-purpose slowspeed handpieces. Because of the absence of these criteria, some means of evaluation had to be established to allow the U.S. Air Force to purchase quality handpieces.

The U.S. Air Force Dental Investigation Service compared handpieces of several manufacturers. This report describes the test and evaluation methods and the results of these studies. The information can be used by base dental surgeons to assist in the selection of dental slowspeed handpieces to meet their particular requirements.

TEST METHODS AND EQUIPMENT

Handpiece Power

To obtain the power for each handpiece, it was necessary to find the speed at which they rotated when varying amounts of torque were applied. The handpieces were connected by mandrel to a Magtrol (Model HD-100-7) Dynamometer (Fig. 1), which contained the electromagnetic braking system for increasing the torque.

The Dynamometer was controlled by a Magtrol (Model 4619) Dynamometer Controller and Magtrol (Model 4605C) Digital Indicator. The controller was used to automatically increase the torque at a constant rate from zero to stall torque for each handpiece. The signals from the controller were transported to a Hewlett-Packard (Model 7047) X-Y Recorder, which produced torque vs. speed curves.

Each handpiece was operated according to manufacturer recommendations, and torque was increased until the handpiece stalled. The power of the handpieces was calculated, in watts, with the data from the torque vs. speed curves.

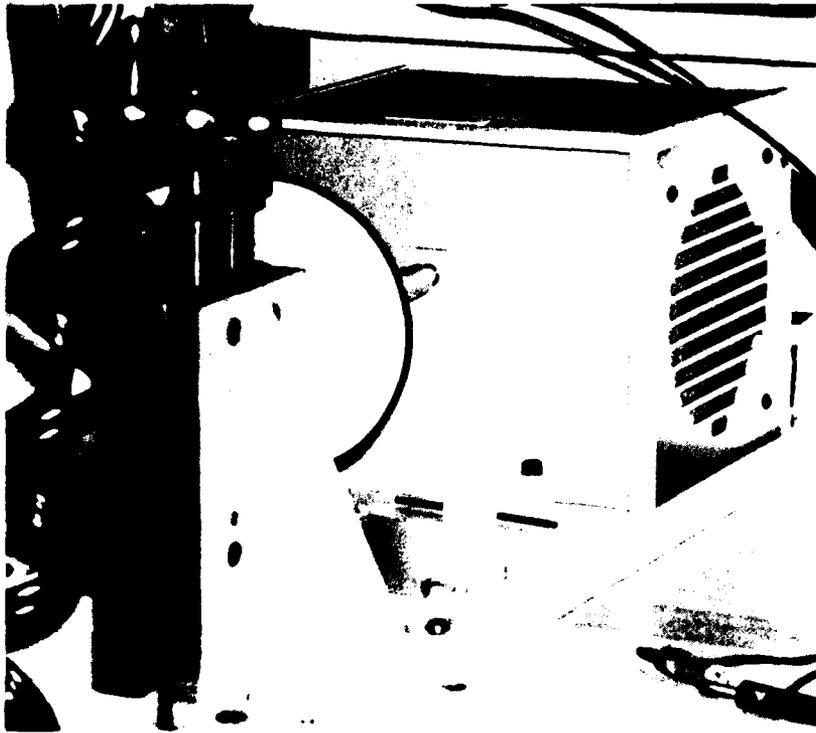


Figure 1. Magtrol (Model HD-100-7) dynamometer.

User Evaluation

A user evaluation of the handpieces was performed at the Wilford Hall Medical Center, TX, David Grant Medical Center, CA, and Tyndall AFB Dental Clinic, FL. The evaluators were:

Col. Dick W. Sanders
Col. John T. Stamps
Col. Robert D. Cowan
Lt Col. Carl D. Haveman
Lt Col. Norman J. Sykes
Maj. Clifford W. Cornelius
Maj. Kevin M. Gureckis

The evaluators' comments are included in the evaluation of data section.

EVALUATION OF DATA

Test Samples

The dental slowspeed handpieces that were evaluated are given in Table 1.

TABLE 1. GENERAL INFORMATION

Handpiece	Distributor
AM 40 Shorty (ISO)	American Midwest/ Sybron 901 West Oakton St. Des Plaines, IL 60018
25D 15E	Bell International 1299 Old Bayshore Hwy #203 Burlingame, CA 94010
181H Intra-K Motor 186B	KaVo America 2200 W. Higgins Rd. Suite 350 Hoffman Estates, IL 60195
Robin Cordless	Kaycor International 1732 Central St. Evanston, IL. 60201
Titan-2 Plus	Star/Syntex Dental P.O. Box 896 Valley Forge, PA 19482
Heavy Duty High Energy	Storz Instrument Co. 3365 Tree Ct. Industrial Blvd. St. Louis, MO 63122
Roto Osteotome 10	Stryker 420 Alcott Street Kalamazoo, MI 49001
Micro-Drill	Zimmer/AMSCO/Hall Boggs Industrial Park P.O. Box 708 Warsaw, IN 46580-0708

American Midwest AM 40 Handpiece

The Midwest AM 40 handpiece (Fig. 2) was evaluated according to the manufacturer's recommended air pressure of 40 psi. The torque vs. speed curve is given in Figure 3. The handpiece was equipped with International Specifications Organization (ISO) couplings and could be easily changed with various handpiece attachments, including the surgical attachment shown in Figure 4.

The operative evaluators felt that the handpiece was lightweight, well balanced, and quieter than other slowspeed handpieces. The handpiece was reliable, and normal maintenance was easy. The handpiece required lubrication only before sterilization. The users liked the release for latch-type burs. The handpiece had good torque response.

The surgical evaluators felt that the handpiece could provide good service for minor oral surgery involving bone and root structure. The handpiece also had the cutting efficiency comparable to most Stryker Roto-Osteotomes, but tooth sectioning was difficult since the torque was less than optimal. The surgical attachment has an easy bur-locking device. The irrigation line interfered with the field-of-vision and was not required.



Figure 2. Midwest AM 40 handpiece and attachments.

AM 40 HANDPIECE

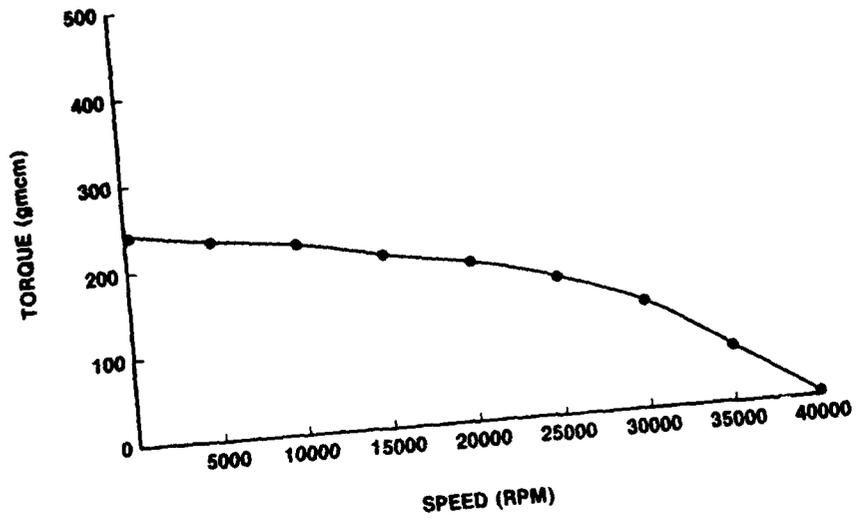


Figure 3. Midwest AM 40: torque vs. speed curves.

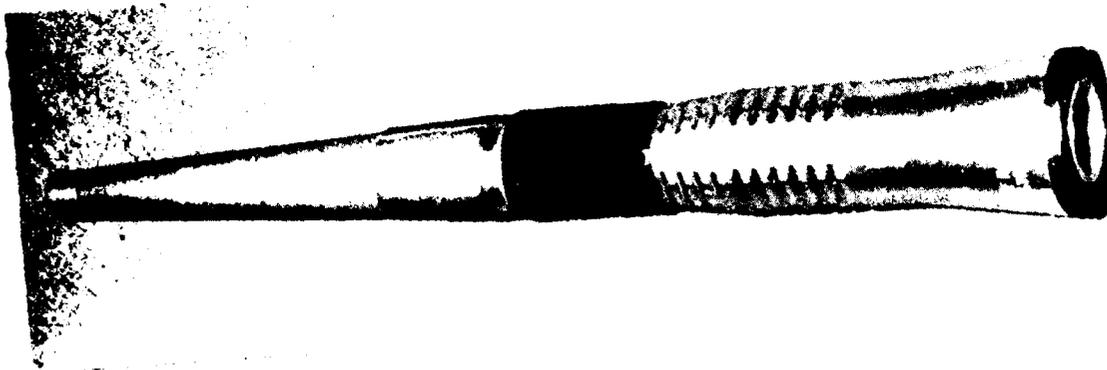


Figure 4. Midwest (ISO) surgical attachment.

American Midwest Shorty (ISO) Handpiece

The Midwest Shorty (ISO) handpiece (Fig. 5) was evaluated according to the manufacturer's recommended air pressure of 40 psi. The torque vs. speed curves, with settings at 0-6,000 rpm and 0-30,000 rpm, are given in Figure 6.

The handpiece had the same performance as the stocklisted Shorty except that the changing of attachments was made easier with the ISO coupling. The evaluators liked the push-button release for latch-type burs (Fig. 7).

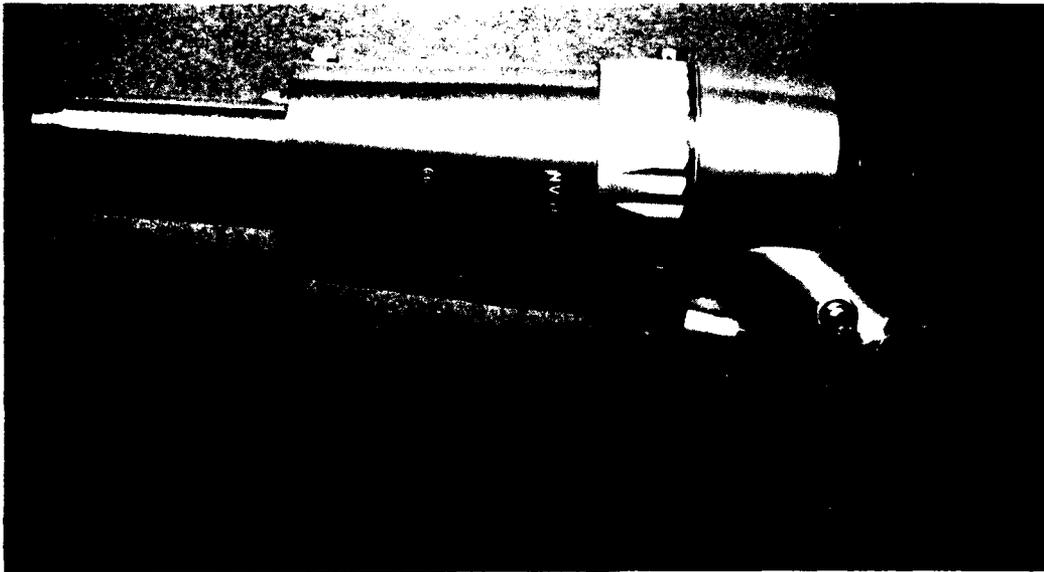


Figure 5. Midwest Shorty (ISO) handpiece.

SHORTY HANDPIECE

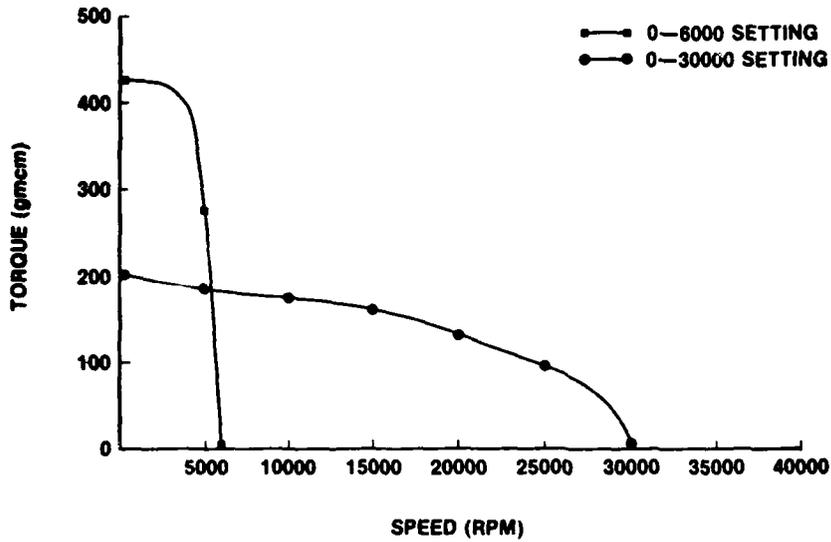


Figure 6. Midwest Shorty: torque vs. speed curves.

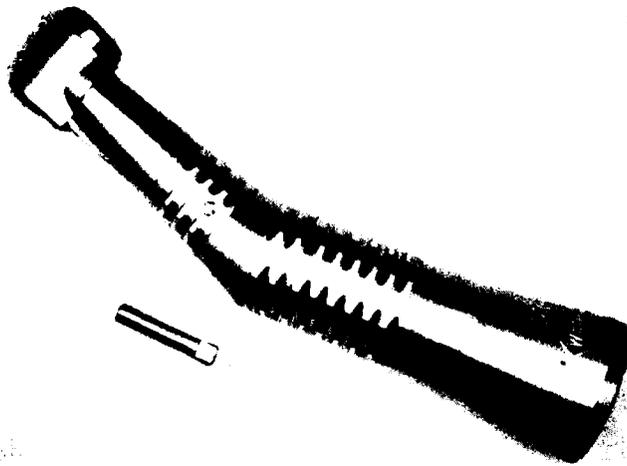


Figure 7. Midwest attachment with push-button latch release.

Stryker Roto Osteotome 10 Handpiece

The Stryker Roto Osteotome 10 (Fig. 28) was evaluated at various pressures using bottled nitrogen as the drive air. The torque vs. speed curves are given in Figure 29. The connector, hose, and exhaust silencer are shown in Figure 30.

The surgical evaluators found the Roto Osteotome 10 to be a versatile handpiece. The foot control was preferred because the finger control was not of proper length. The handpiece with bur guards provided ease of access to confined areas.

Some disadvantages were noted. The handpiece and hose were cumbersome and not well balanced. The handpiece required special notched burs. Lubrication procedures must be strictly followed for proper performance.

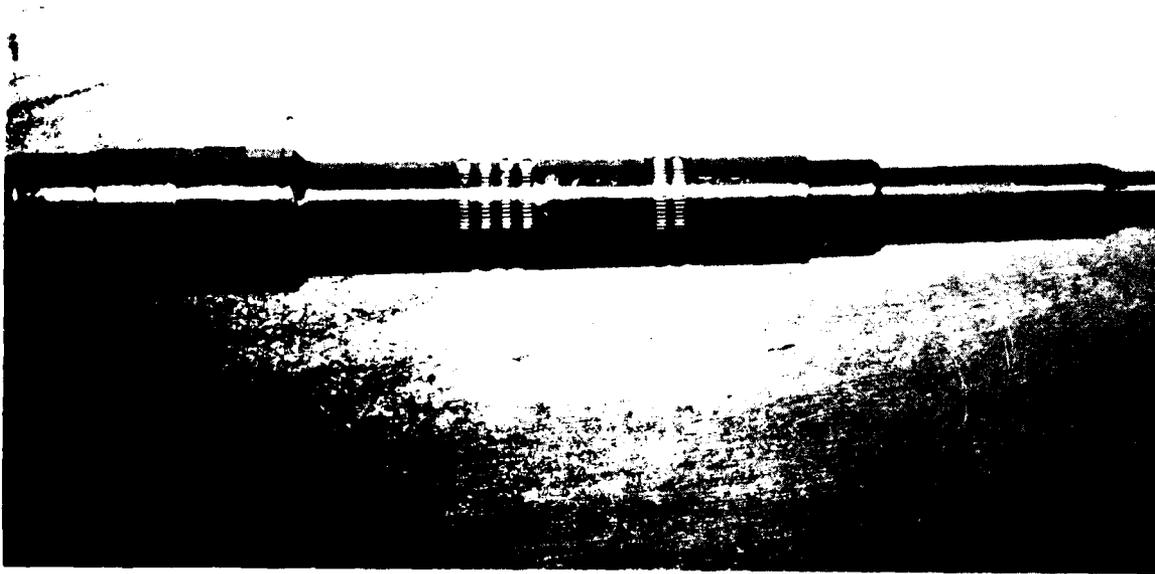


Figure 28. Stryker Roto Osteotome 10 handpiece.

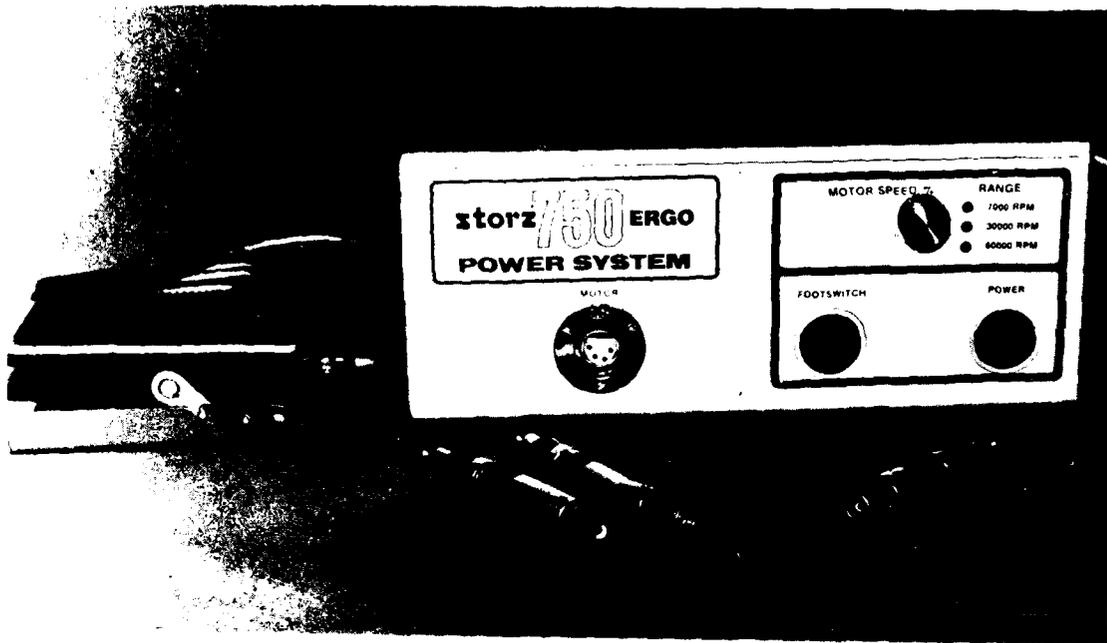


Figure 26. Storz Ergo 750 power unit.

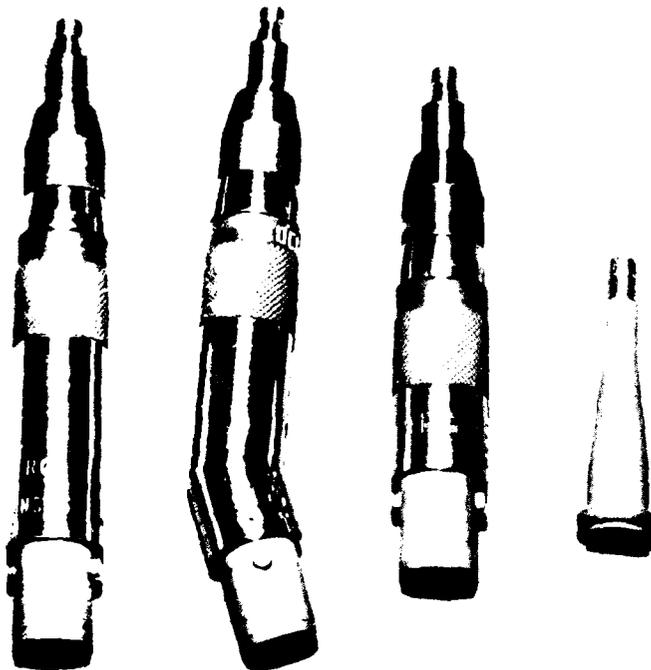


Figure 27. Storz surgical attachments.

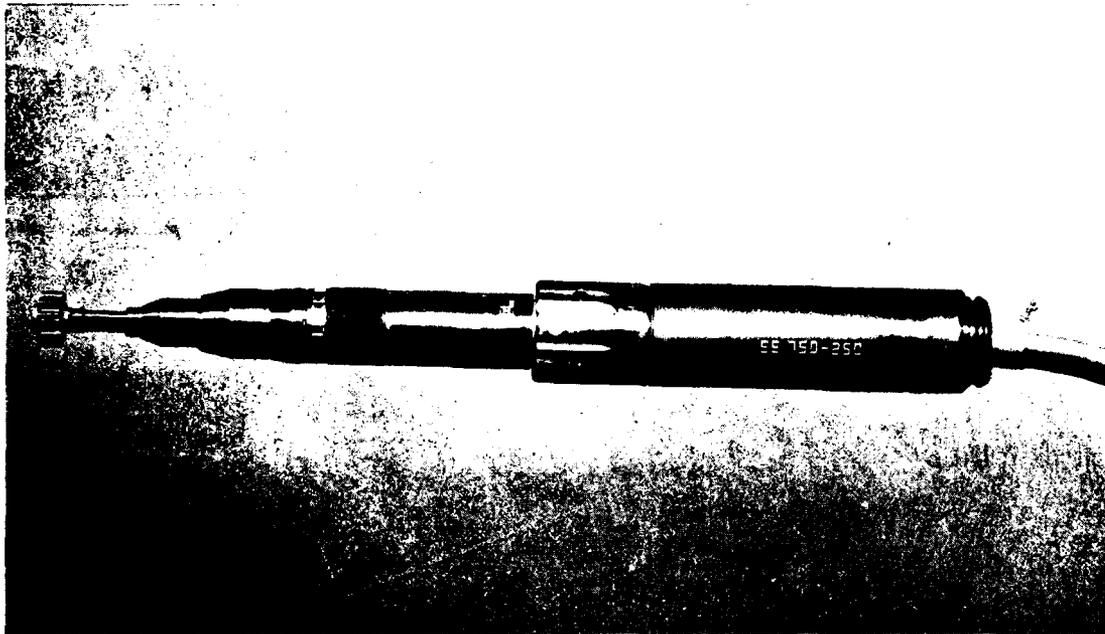


Figure 24. Storz High Energy surgical handpiece.

STORZ HANDPIECE

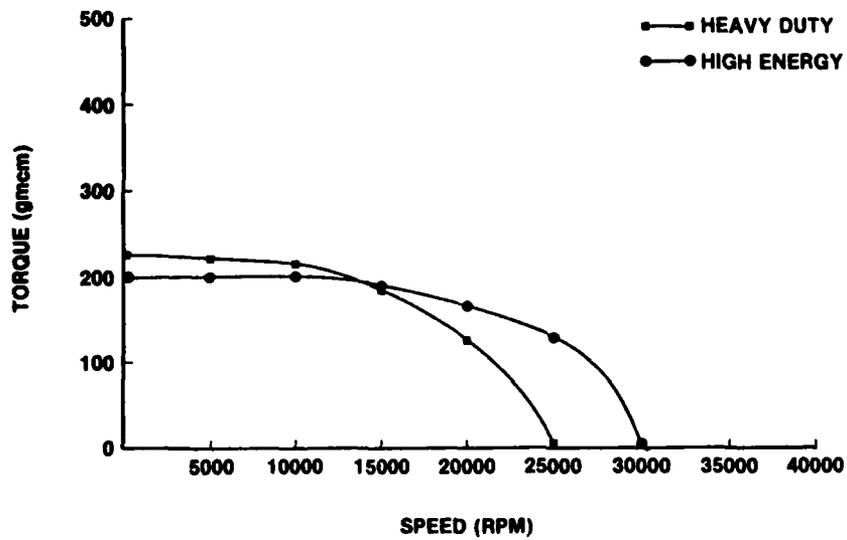


Figure 25. Storz Handpieces: torque vs. speed curves.

Storz Heavy Duty and High Energy Handpieces

The Storz Heavy Duty (Fig. 23) and High Energy (Fig. 24) Electrical Surgical Handpieces were evaluated with the Ergo 750 power system. The torque vs. speed curves are given in Figure 25. Several surgical attachments and the power system are shown in Figures 26 and 27.

The surgical evaluators found that the High Energy handpiece weighed similar to the Hall and Stryker Roto Osteotomes. The Heavy Duty handpiece was inordinately heavy and totally inadequate for oral surgical use. The High Energy handpiece could be fully sterilized, and the motor required no lubrication.

The 750 console was compact, easily cleaned, and had simple controls. The variable speed foot control was a convenient size and could be effectively positioned. The unit operated on 110V 60 Hz.

The bur locking device was a simple mechanism, requiring no additional wrenches or instruments. During the test period, the system worked flawlessly and required no lubrication or care other than routine cleaning and sterilization. The notched burs came in three lengths and multiple configurations. Four sizes of bur guards were also available.

The users strongly recommended the High Energy handpiece. The handpiece was of solid construction, simple design, and excellent cutting efficiency. Ease of maintenance was especially noteworthy. With the variable selection of bur types it was felt that most oral surgical procedures, including osteotomies and fracture reductions, could be accomplished using the High Energy instrument package. This system could prove to be an appropriate replacement for existing pneumatically driven handpieces in use throughout most oral surgery clinics.

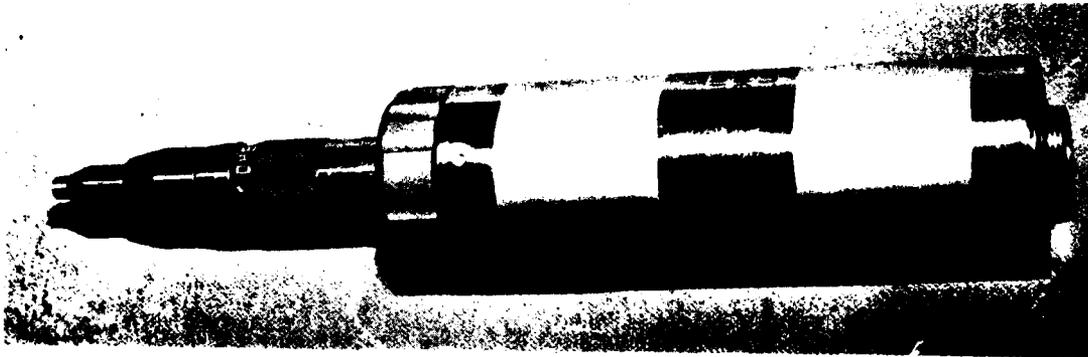


Figure 23. Storz Heavy Duty handpiece.

STAR HANDPIECE

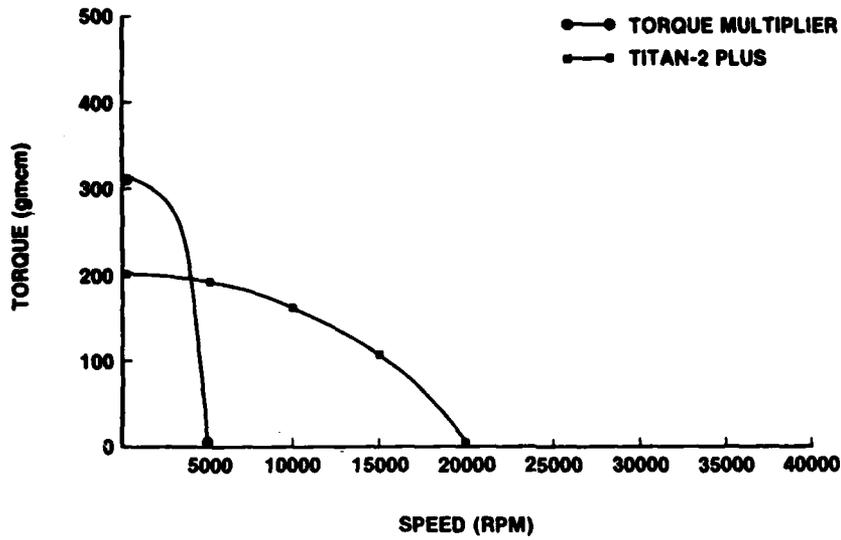


Figure 21. Star Titan-2 Plus: torque vs. speed curves.

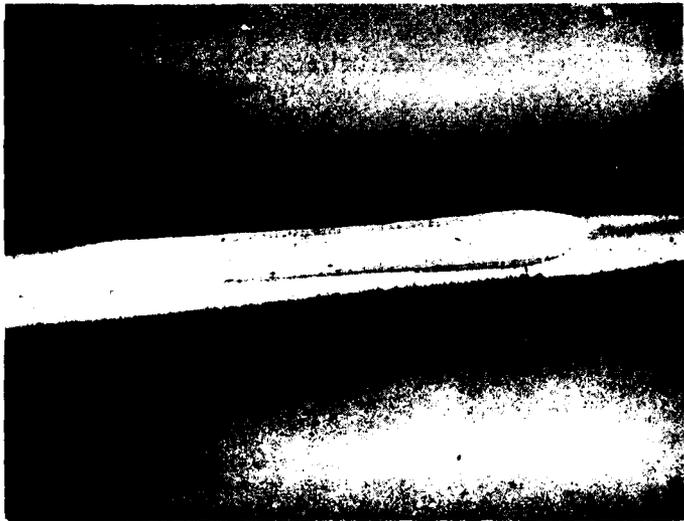


Figure 22. Star Titan-2 Plus, pitting due to dry-claving.

Star Titan-2 Plus Handpiece

The Star (Syntex) Titan-2 Plus handpiece (Fig. 20) was evaluated according to the manufacturer's recommended air pressure of 45 psi. The torque vs. speed curves are given in Figure 21.

The operative evaluators felt that the handpiece was lightweight and well balanced. The torque was extremely well suited for restorative procedures. The ease of changing handpiece heads was an advantage. Lubricating of the various angles was time consuming and required care. The handpiece was incorrectly dry-claved causing pitting of the metal (Fig. 22). However, when correctly autoclaved and chemiclaved, the handpiece could be fully sterilized.

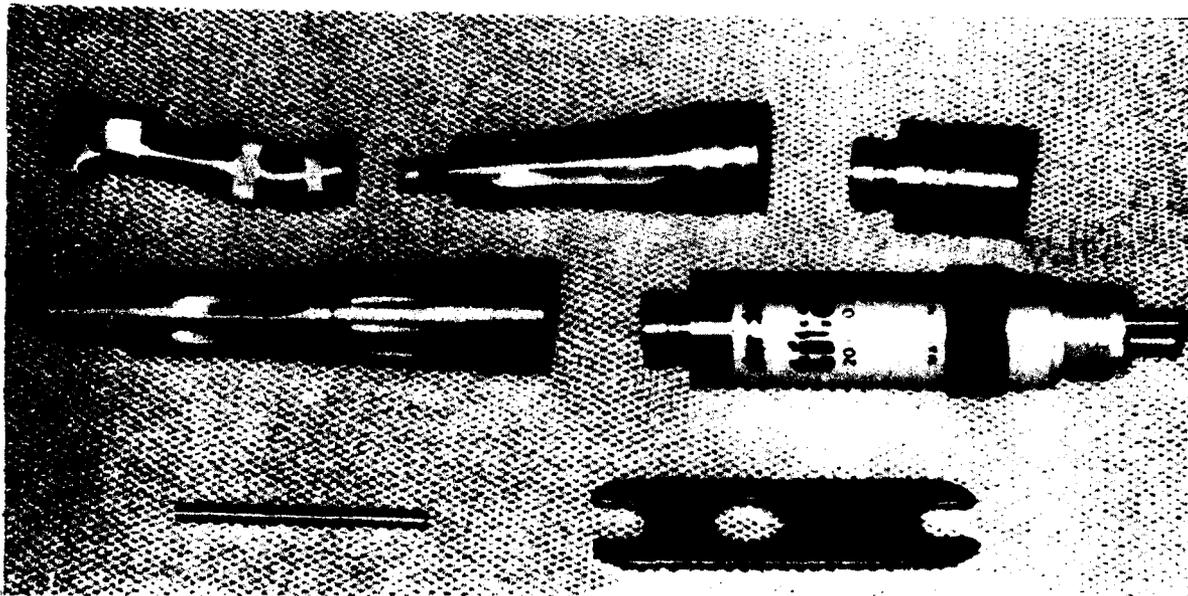


Figure 20. Star Titan-2 Plus handpiece with attachments.



Figure 18. Robin cordless electric handpiece out of recharging stand.

**ROBIN HANDPIECE
(FULLY CHARGED)**

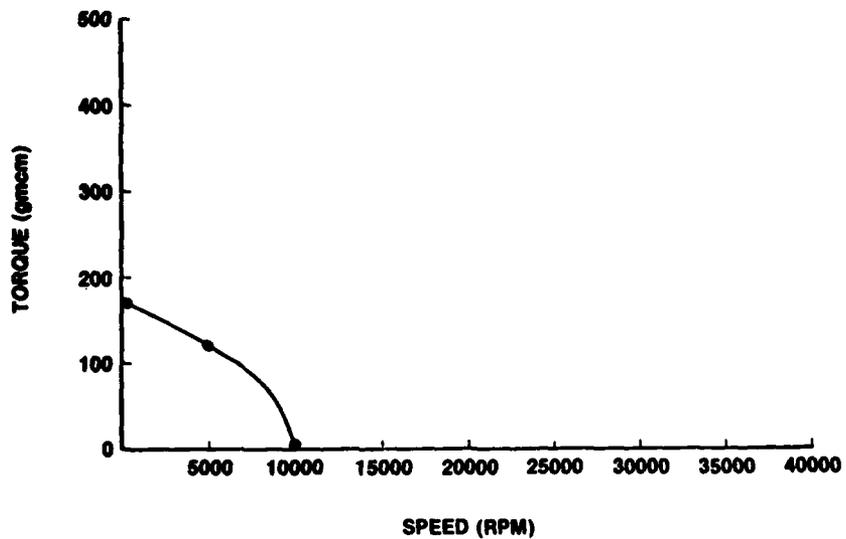


Figure 19. Robin handpiece: torque vs. speed curve.

Robin Cordless Handpiece with Recharging Stand

The Robin Cordless handpiece with recharging stand (Yoshida of Japan) (Figs. 17, 18) was evaluated. The torque vs. speed curve of the fully charged handpiece is given in Figure 19. A life test of continuous operation with no load lasted for only 30 min before the handpiece stopped. The battery charger operated on 110V and was used to recharge batteries in the handle of the handpiece.

The users did not like the fact that the handpiece could not be sterilized and would not hold friction grip burs. The handpiece was convenient to use in wards for treating nonambulatory patients or in an emergency.



Figure 17. Robin cordless electric handpiece, with recharging stand.

KAVO INTRA-K HANDPIECE

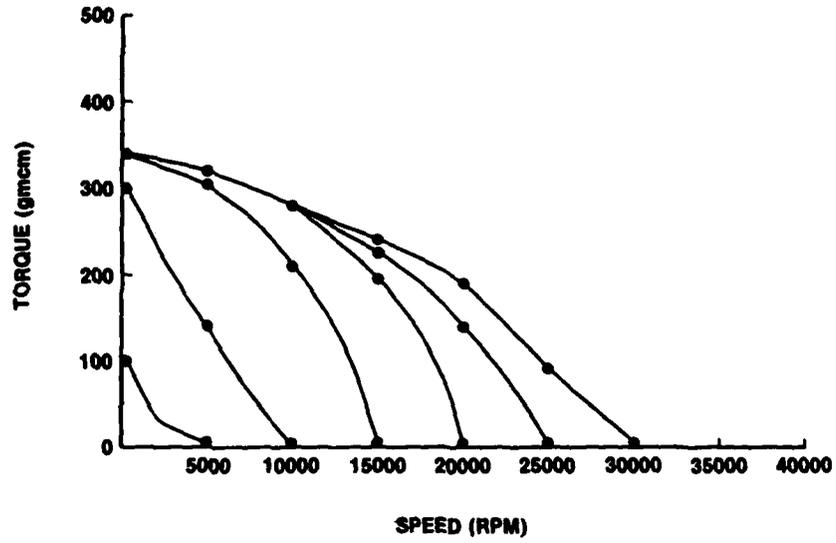


Figure 15. KaVo Intra-K: torque vs. speed curves.

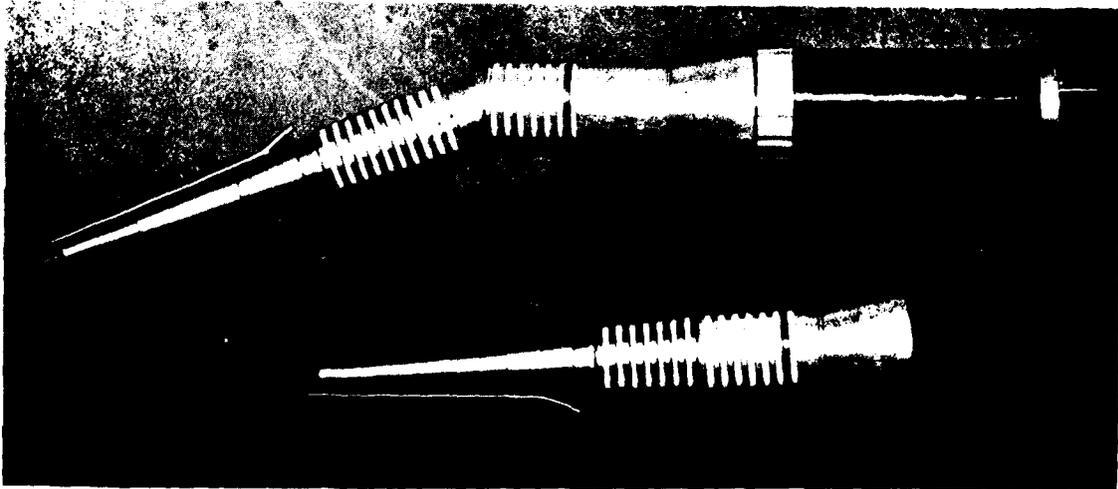


Figure 16. KaVo Intra-K with surgical attachments.

KaVo Intra-K Motor 186 B Handpiece

The KaVo Intra-K 186 B handpiece (Fig. 14) was evaluated with the Model 946 floor stand power unit. The torque vs. speed curves, at various starting speeds, are given in Figure 15. The handpiece is available in 120V, 220V or 240V 50/60 Hz.

The user evaluators felt that the ISO coupling provided a wide variety of handpiece combinations. The evaluators also thought that the power box was obtrusive and could not be maintained aseptically, and that the water spray tube was in an obstructive location (Fig. 16).

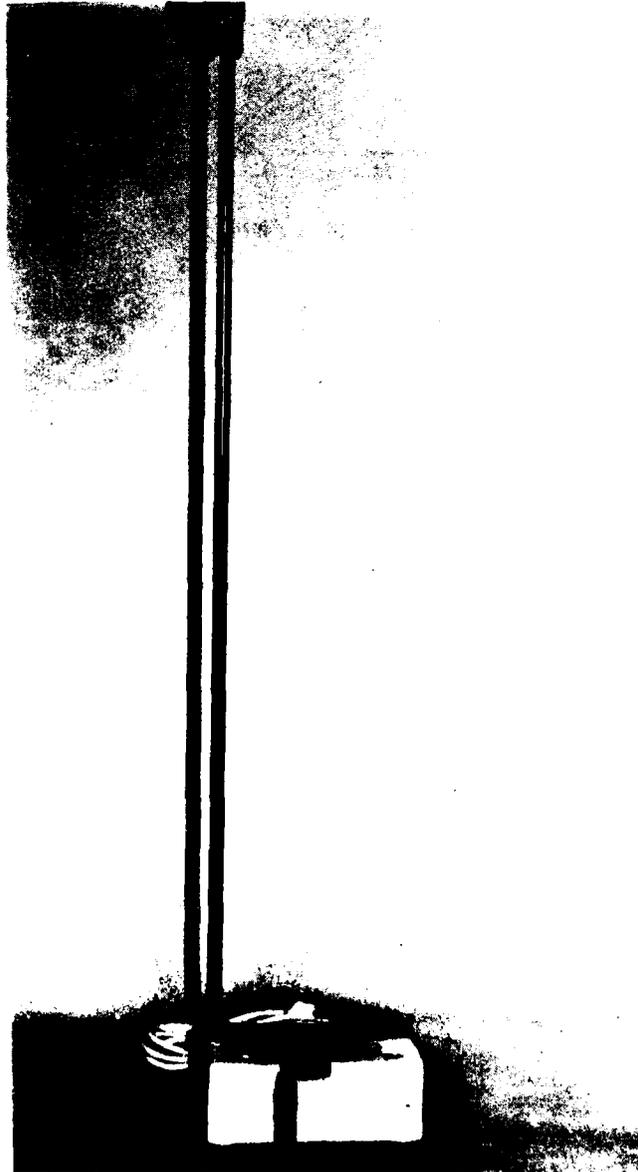


Figure 14. KaVo Intra-K Electric handpiece with power unit.

KAVO 181H HANDPIECE

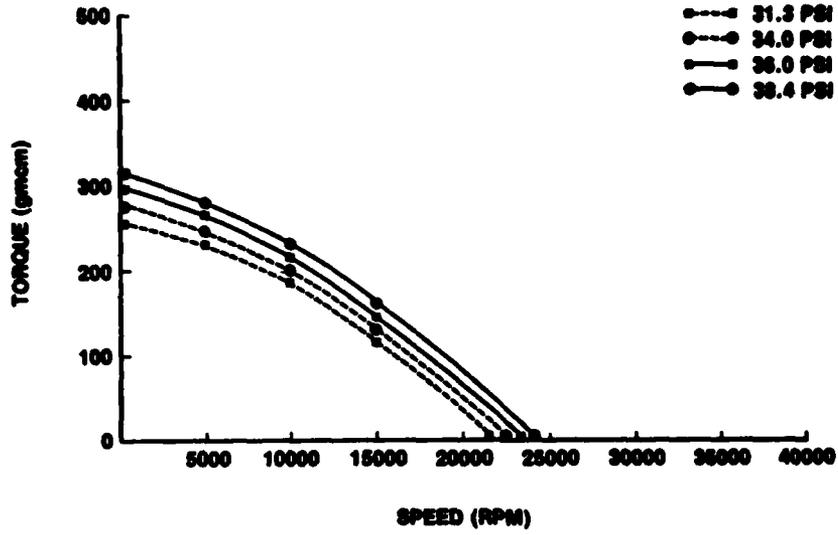


Figure 12. KaVo 181 H: torque vs. speed curves.

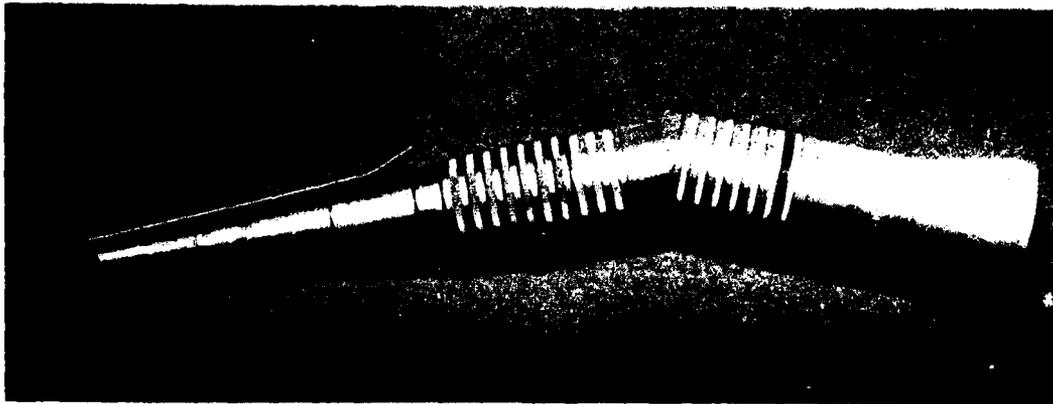


Figure 13. KaVo angled surgical attachment.

KaVo 181 H Handpiece

The KaVo 181 H slowspeed handpiece (Fig. 11) was evaluated according to the manufacturer's recommended air pressure of 31.3 to 38.4 psi. The torque vs. speed curves, at various pressure settings, are given in Figure 12.

The operative evaluators felt that the handpiece had good feel and balance. The evaluators liked the quick change of burs and the attachments. The handpiece torque was good, and the handpiece was easy to maintain. The handpiece seemed noisier than other slowspeed handpieces. The air/water spray tube was in an obstructive location. There was some difficulty in meshing gears when attachments were changed.

The surgical evaluators liked the broad selection of handpiece combinations provided with the ISO coupling. The handpiece had a good bur lock. The handpiece required lubrication only before sterilization, not afterwards. The handpiece had good speed and torque for its air pressure. The unit was adequate for occasional minor surgical procedures for bone removal and cutting root structure; however, it was not adequate for heavy, sustained hard tissue sectioning. The air/water spray tube was also in an obstructive location (Fig. 13).

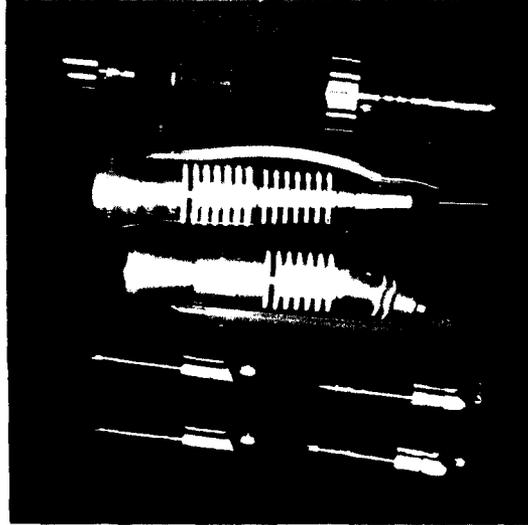


Figure 11. KaVo 181 H handpiece with attachments.

BELL 25D HANDPIECE

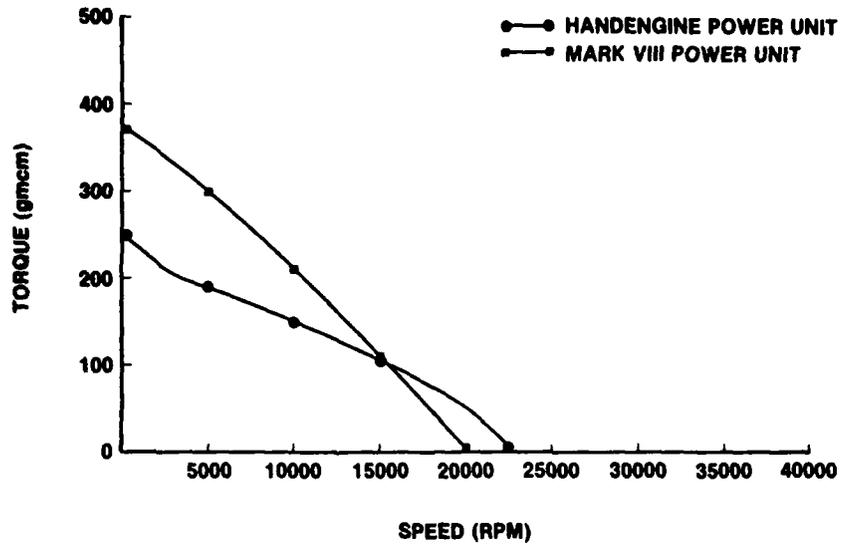


Figure 9. Bell 25 D: torque vs. speed curves.

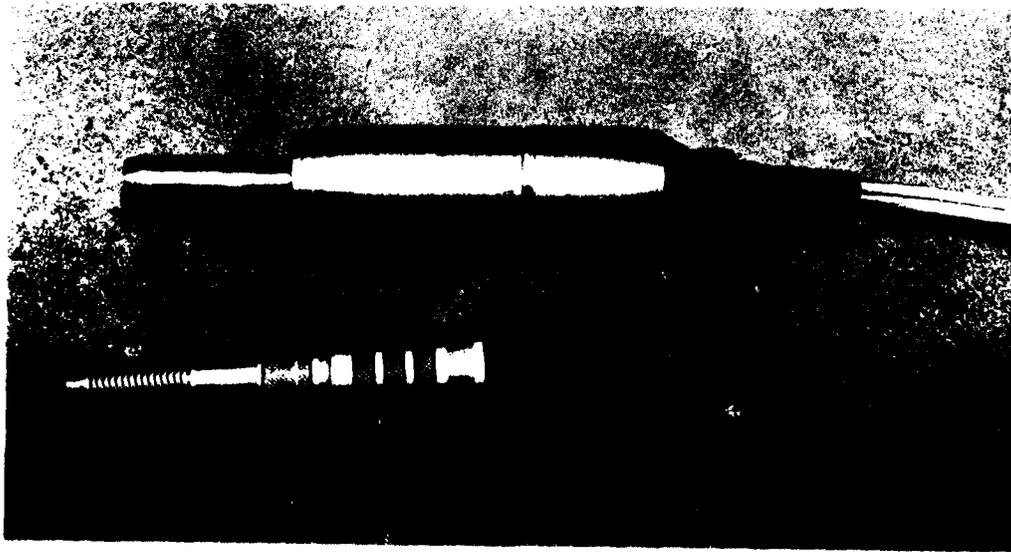


Figure 10. Bell 15 E electric handpiece with attachment.

Bell International 25 D and 15 E Handpieces

The Bell 25 D handpiece (Fig. 8) was evaluated with the handengine electric power unit. The torque vs. speed curves are given in Figure 9. The 15 E (Fig. 10) had the same performance as the 25 D since it is the same handpiece with an ISO coupling. The 25 D was also operated with the Mark X rheostat foot control and the Mark VIII rechargeable battery power pack. The rheostat foot control produced the same speed curve as the handengine. The speed curve for the rechargeable battery power pack is shown in Figure 9.

Operative evaluators were reluctant to use the Bell 25 D and 15 E intra-orally due to exposed electrical wiring and lack of asepsis control. With the handengine power unit, the user could only set a speed and then the foot control only acted as an on-off switch leaving the user with no speed control while operating. A 20-EORL, Micro-Surgical kit was evaluated with the 15 E, but was impractical for dentistry. The handpieces did not have adequate torque for sufficient infiltration of hard tissue during oral surgery.

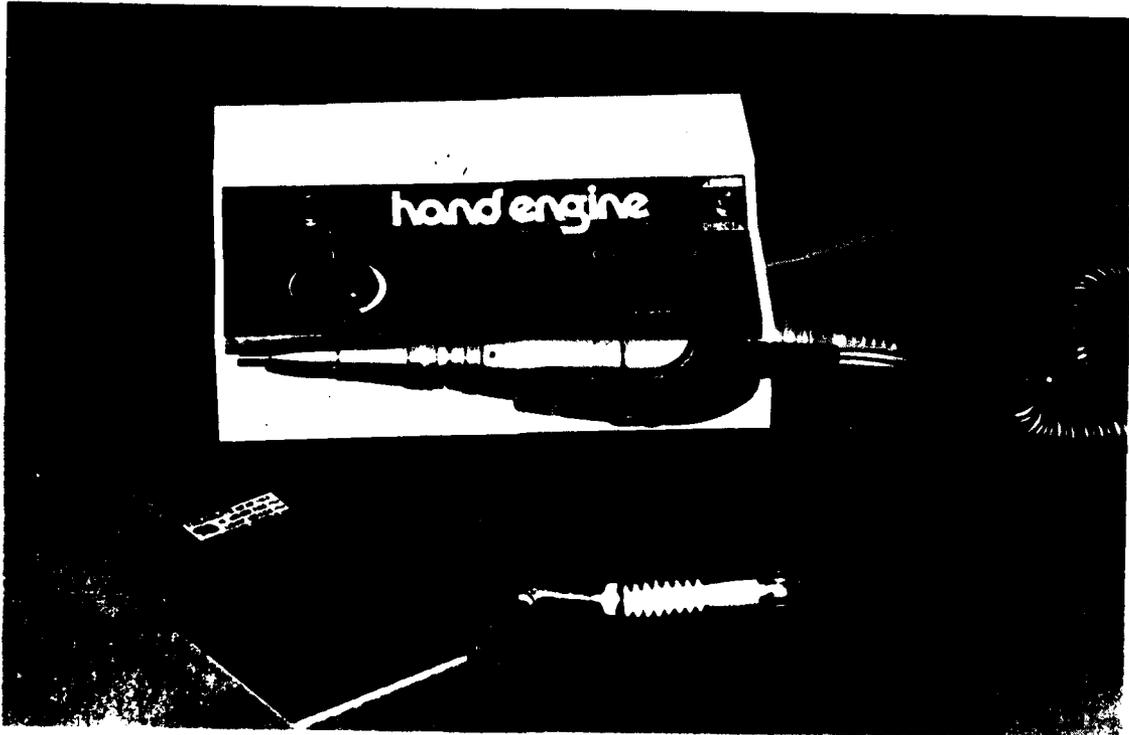


Figure 8. Bell 25 D electric handpiece with power unit.

STRYKER SURGICAL HANDPIECE

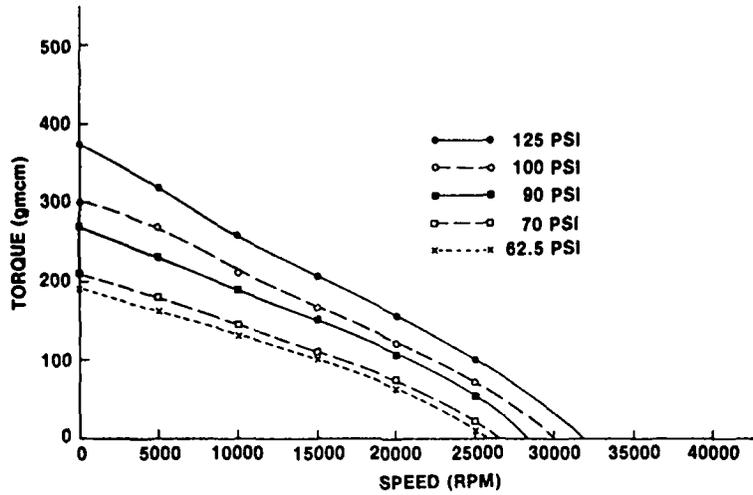


Figure 29. Stryker Roto Osteotome 10: torque vs. speed curves.

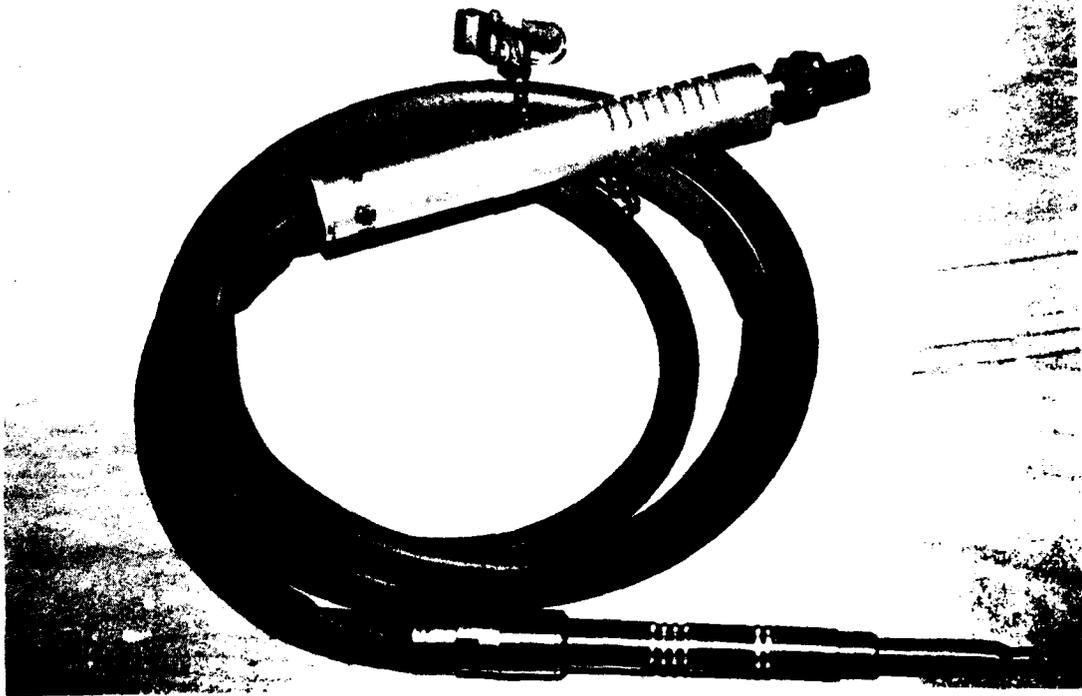


Figure 30. Stryker Roto Osteotome 10 accessories.

Zimmer/AMSCO/Hall Micro-Drill Handpiece

The Hall Micro-Drill (Fig. 31) was evaluated at various pressures using bottled nitrogen as the drive air. The torque vs. speed curves are given in Figure 32. The connector and hose are shown in Figure 33.

The surgical evaluators found the Micro-Drill to be more acceptable to patients due to decreased noise. The handpiece had good weight distribution. The handpiece required no lubrication. Standard burs were used and often there was not enough length to reach confined areas. The footswitch was used because the finger control did not allow for variation of cutting speed.



Figure 31. Hall Micro-Drill handpiece.

HALL SURGICAL HANDPIECE

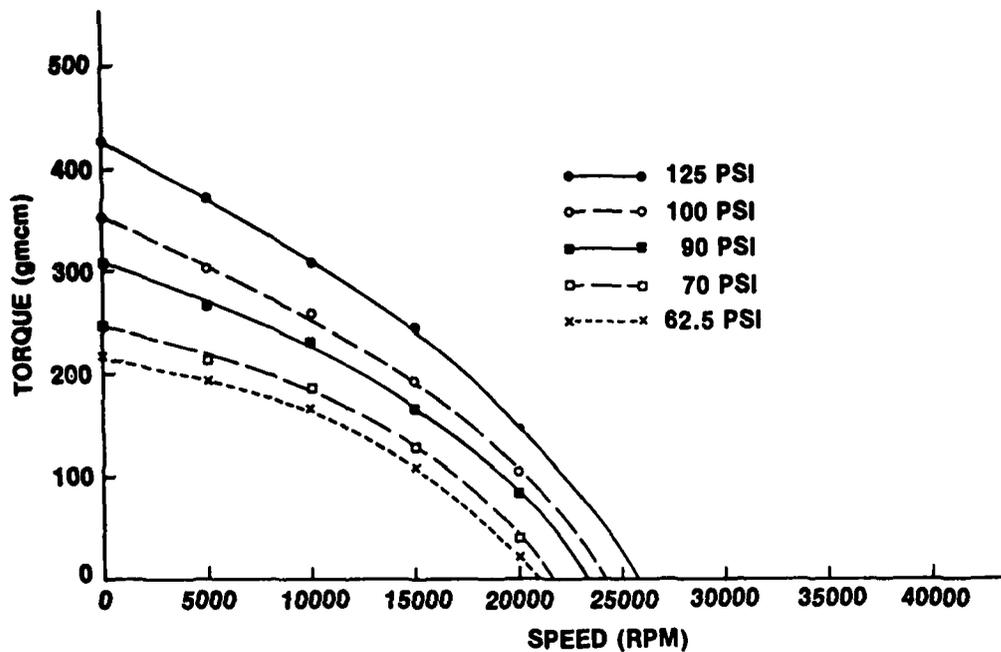


Figure 32. Hall Micro-Drill: torque vs. speed curves.



Figure 33. Hall Micro-Drill accessories.

CONCLUSIONS

The selection of dental multi-purpose slowspeed handpieces depends almost entirely upon the needs of the respective dental clinic and its mission. All units tested essentially performed the tasks for which they were designed. The cost, design, quality of construction, ease of repair, size and portability should be weighed according to local demands. The power vs. speed curves of the operative handpieces tested are given in Figure 34, and of the surgical handpieces in Figure 35.

The information provided by this report can be used by the base dental surgeon as an aid in purchasing dental multi-purpose slowspeed handpieces. Any questions should be directed to the Dental Investigation Service, USAFSAM/NGD, Brooks AFB, TX 78235-5301, Autovon 240-3502, Commercial (512) 536-3502.

OPERATIVE HANDPIECES

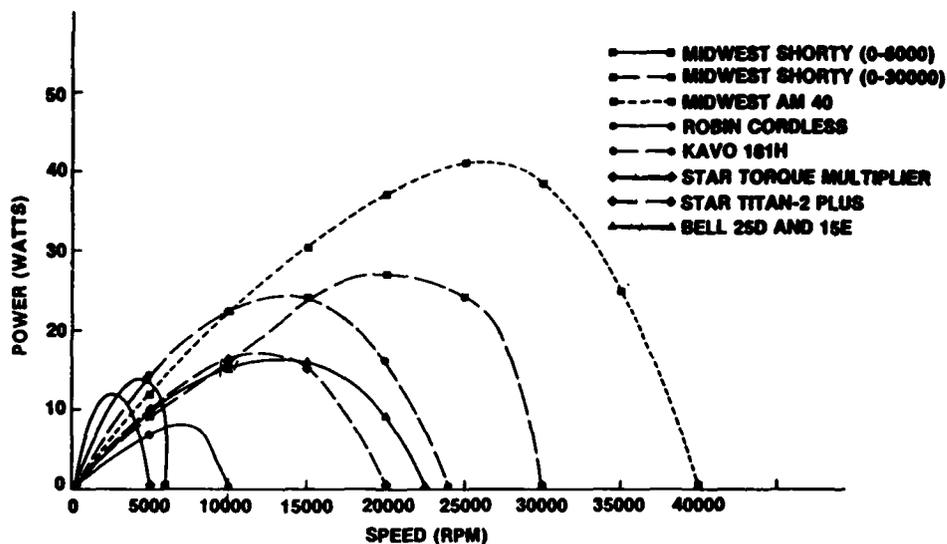


Figure 34. Comparison of operative handpiece power vs. speed curves.

SURGICAL HANDPIECES

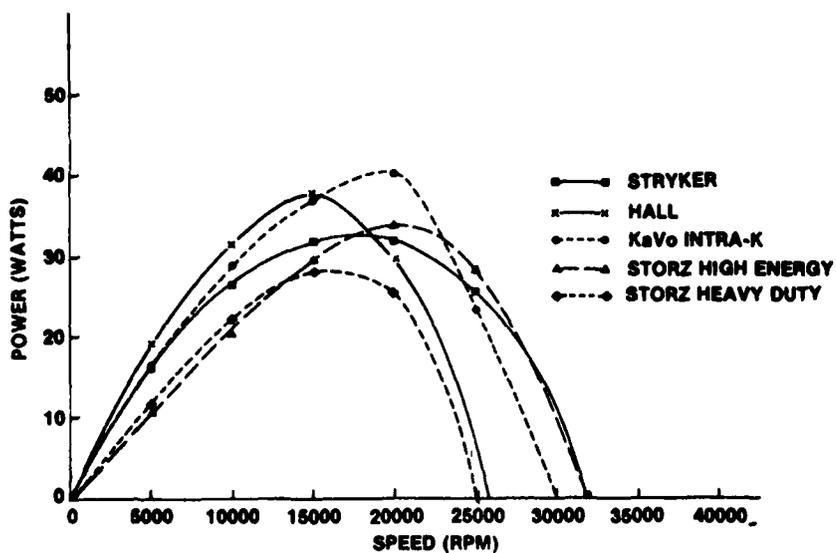


Figure 35. Comparison of surgical handpiece power vs. speed curves.

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