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THE DENTAL ADVISOR

3110 West Liberty
Ann Arbor, MI 48103
Toll free: 800.347.1330
E-mail: info@dentaladvisor.com
Web Site: www.dentaladvisor.com

NUMBER 42 - FEBRUARY 2012

Torque Versus Speed Characteristics of Three 45° Handpieces

R. Yapp, M.S., J.M. Powers, Ph.D.
THE DENTAL ADVISOR Biomaterials Research Center
Dental Consultants, Inc., Ann Arbor, Michigan

Purpose – The purpose of this project was to measure the torque versus speed characteristics of three different handpieces and to compare their ability to perform under different loading scenarios and at different supply air pressures.

Experimental Design –

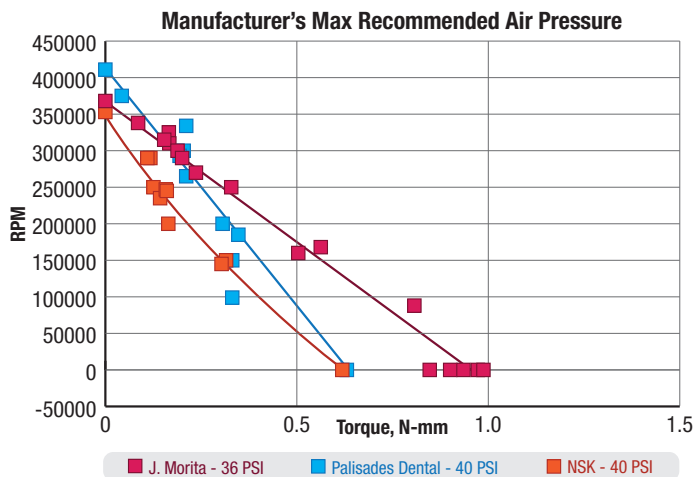
Handpieces: J. Morita TwinPower Turbine 45 (4H PAR-4HEX-O-45) [SN Z 30134]
NSK Titanium High Speed Air Turbine Handpiece (NL-45K-S) [SN CMY 01717]
Palisades Dental Impact Air 45 High Speed Handpiece [SN P51680]

Dependent variables: stall torque, torque versus speed curve

Independent variables: manufacturer’s highest recommended air pressure, 35 psi, 30 psi, and 25 psi

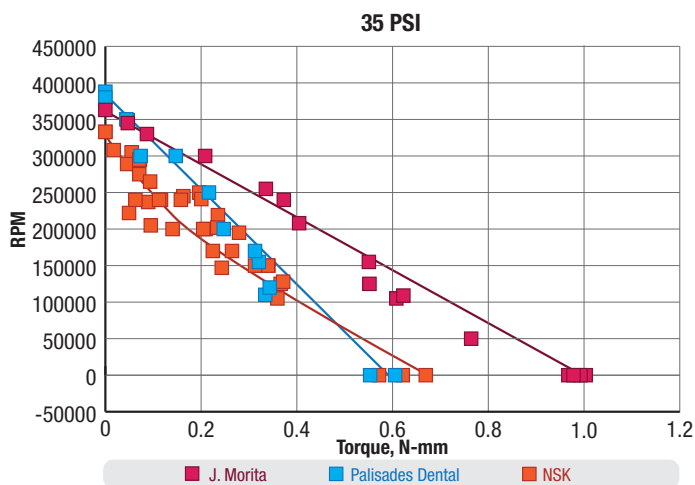
Materials and Methods – The handpieces were secured one at a time to THE DENTAL ADVISOR Handpiece Test Platform. The brake rotor, a 1.60 mm diameter steel shank with a 6.35 mm diameter ball at one end, was inserted into the chuck of the handpiece, which was then attached to the handpiece pivot assembly and adjusted so that the ball was aligned with the center of the torque sensor turret. The speed of the brake rotor, which was painted longitudinally half black and half white, was measured with a infrared speed sensor (Monarch) and tachometer (ACT 3 Electronic Tachometer). A silk thread was attached at one end to the load cell of an universal testing machine (Instron 5866) on which the test platform was mounted and the other end wound around and attached to the pulley (26.7 mm diameter) of the torque sensor turret. During the testing, the handpiece was pressed downward along the axis of the chuck shaft with varying loads so that the brake rotor was pushed against the asbestos brake pad, which was attached to the top of the torque sensor. The friction of the brake rotor against the brake pad produced a torque in the torque sensor, which was registered by the load cell as a force. The torque was calculated as the product of this force times the radius of the turret pulley. Several torque versus speed data points were taken to define the torque versus speed curve for each handpiece. Each torque versus speed curve was charted on a single graph for each air pressure for comparison purposes. The stall torque was determined by pivoting the brake rotor into the brake pad with enough force to stop the brake rotor. The torque so generated and measured by the force in the thread attached to the load cell was defined as the stall torque. It can be read directly from the torque versus speed graphs at zero rpm.

Results –



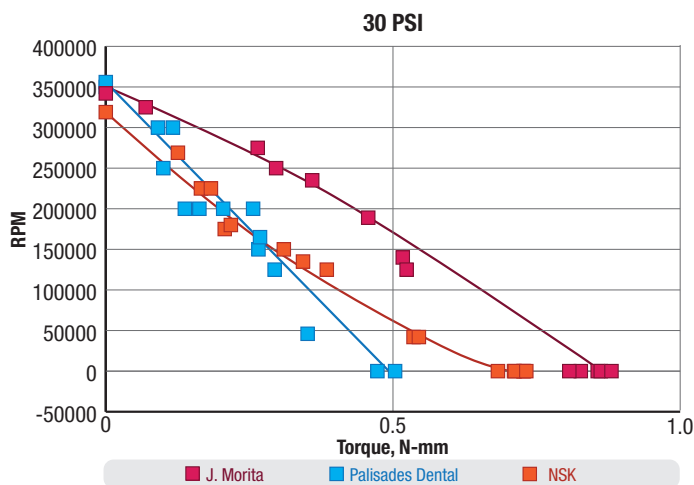
A. Torque versus speed curves at manufacturer’s maximum recommended air pressure

Note: Stall torque of the *J. Morita TwinPower Turbine 45* is 50% greater than either of the other two handpieces.



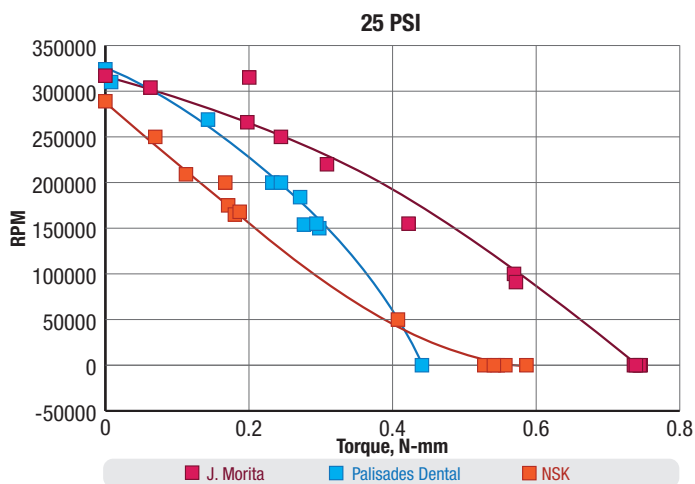
B. Torque versus speed curves at 35 psi

Note: At a supply air pressure of 35 psi, the stall torque of the *J. Morita TwinPower Turbine 45* was 63% higher than the *Palisades Dental Impact Air 45 High Speed Handpiece* and 48% higher than the *NSK Titanium High Speed Air Turbine Handpiece*.



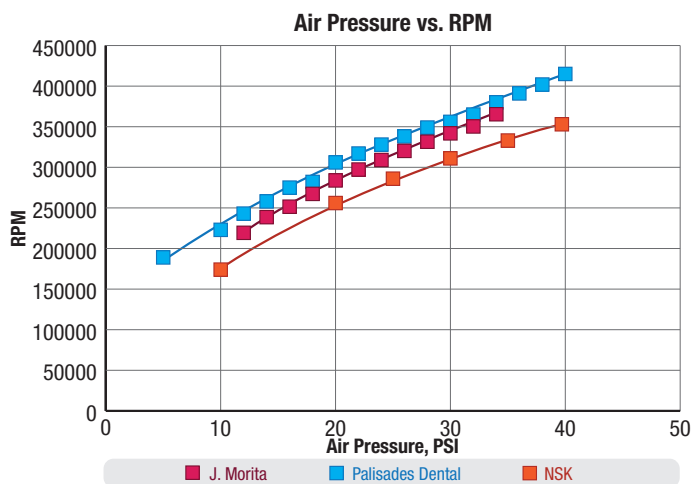
C. Torque versus speed curves at 30 psi

Note: At a supply air pressure of 30 psi, the stall torque of the *J. Morita TwinPower Turbine 45* was 64% higher than the *Palisades Dental Impact Air 45 High Speed Handpiece* and 11% higher than the *NSK Titanium High Speed Air Turbine Handpiece*.



D. Torque versus speed curves at 25 psi

Note: At a supply air pressure of 25 psi, the stall torque of the *J. Morita TwinPower Turbine 45* was 68% higher than the *Palisades Dental Impact Air 45 High Speed Handpiece* and 25% higher than the *NSK Titanium High Speed Air Turbine Handpiece*.



E. Handpiece supply air pressure versus rpm

Conclusions –

1. The *J. Morita TwinPower Turbine 45* exhibited higher torque versus speed curves than the other two handpieces at supply air pressures of 35, 30, and 25 psi.
2. The *Palisades Dental Impact Air 45 High Speed Handpiece* demonstrated the highest speed (410,000 RPM) at zero torque.
3. The *J. Morita TwinPower Turbine 45* exhibited the highest stall torque of the three handpieces tested at all supply air pressures tested.

This project was funded in part by J. Morita.