Incisal Dental Microwear of the Prehistoric Point Hope Communities: A Dietary and Cultural Synthesis

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INCISAL DENTAL MICROWEAR OF THE PREHISTORIC POINT HOPE COMMUNITIES: A DIETARY AND CULTURAL SYNTHESIS

by

Kristin L. Krueger

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
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Department of Anthropology

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Kristin L. Krueger
The prehistoric coastal communities of Point Hope, Alaska have been considered important Arctic archaeological sites since their initial excavations in 1939. The majority of the archaeological artifacts are grouped into two temporally distinct cultural components, the Ipiutak (2100-1500BP) and the Tigara (800-300BP). Although debated, Arctic archaeologists have suggested that the Ipiutak depended heavily on land mammals with only seasonal reliance on sea mammals, whereas the Tigara relied primarily on sea mammals including whales. While both groups clearly utilized foraging subsistence economies, the contrasts in their food acquisition strategies would have placed different demands on the males and females, particularly with regard to paramasticatory behavior. This paper addresses aspects of the gender-based division of labor in the Ipiutak and Tigara through an analysis of their patterns of incisal dental microwear.
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CHAPTER I

INTRODUCTION

Arctic foragers have long been of interest to anthropologists, other researchers and the general public alike. This interest stems from the arduous arctic environment in which they live. Questions have continually been asked as to how successful these arctic communities were in the recent past. Several early explorer accounts suggest a thriving area (Beechey 1831; Ray 1885; Simpson 1885). In fact, Sir John Franklin’s account of his 1845 expedition to Alaska stated that all 138 of his men died within three years “while the Eskimos lived around them as they have for...thousands of years” (Andrews 1939:29).

The biological effects of this harsh arctic environment have also been examined. Any undergraduate in a basic biology or anthropology class has had to learn Bergmann’s and Allen’s Rules, which associate extreme cold environments with body mass and length of extremities, respectively. Even early explorer accounts provide physical descriptions of the people they encountered. In fact, John Simpson stated in his 1875 account of the Point Barrow Alaskan Eskimos that both sexes were “strong, and they bear exposure during the coldest weather for many hours together without appearing inconvenienced” (1875:245). Another arctic forager biological feature studied includes whether the morphological features of the face, specifically face shape, is related to cold
adaptation or facial function (i.e. chewing strength) (Cederquist 1979; Cederquist et al. 1977; Dahlberg et al. 1978; Mayhall et al. 1970).

As one can see, arctic foragers have been the focus of several inquiries by anthropologists and other researchers simply due to the extreme climate in which they lived. As a consequence of these inquiries, several debates have developed. What role, if any, do these biological features have on arctic forager success? What functions do subsistence strategies play? What sort of research needs to be completed to unravel these complex questions?

Initially, it seems like a daunting task; however, focusing these research questions on one debate at a particular site helps to separate out multifaceted issues. One debate concerns the archaeological sites at Point Hope, Alaska (Larsen and Rainey 1948). Point Hope, which is on a peninsula extending 15 miles out into the Arctic Ocean (see Figure 1.1), lies on the northwest coast of Alaska, approximately 200 miles north of the Bering Strait and 125 miles north of the Arctic Circle (Larsen and Rainey 1948). When initially excavated from 1939 to 1941, the original researchers found two distinct sites: Ipiutak and Tigara.

Point Hope was once called “one of the largest and most important archaeological sites in the Arctic” (Rainey 1971:1). The excavations of Rainey and Larsen revealed the Point Hope Ipiutak and Tigara sites to be a cache of settlement and burial data. Included in the over 10,000 artifacts associated with these two cultures were land and sea-mammal hunting implements, sewing tools, ivory carvings, weapons, and ornamental burial
objects associated with over 600 mapped housing units and 400 burials (Larsen and Rainey 1948).

The Ipiutak site lies on the northern marine and alluvial coast of the peninsular tip, whereas the Tigara site lies a mere 600 yards from the western edge of the point (see Figure 1.2; Larsen and Rainey 1948). To the present-day Eskimo residents, the sand and gravel foundation of Point Hope is known as “Tikeraq,” or the index finger (Rainey 1971). Based on C\textsuperscript{14}, Accelerator Mass Spectronomy (AMS) dates and archaeological interpretation, the Ipiutak culture inhabited Point Hope on a seasonal basis, from 2100 to 1500 BP, while the Tigara lived there from 800 to 300 BP (Mason 1998; Newton 2002). During their respective occupations, it is thought that both populations relied on

![Figure 1.1 Map of Alaska](image)
distinctive dietary practices.

Although these two sites demonstrated a vast array of artifacts, they also brought to light several questions concerning the possible subsistence strategies of these two communities. Larsen and Rainey (1948) suggested that the Ipiutak community relied primarily on land mammal hunting, specifically caribou, supplemented with seal and walrus hunting. The Tigara community, on the other hand, relied primarily on whale hunting. Both of these conclusions were based on the initial archaeological data with minimal incorporation of research on the human skeletal remains.

My project examines Ipiutak and Tigara human skeletal remains from Point Hope, currently housed at the American Museum of Natural History (AMNH) in New York City. These skeletal remains, along with associated grave goods, can continue dialogue regarding bio-cultural systems and adaptations to the Arctic environment. Specifically, examining dental remains, which are most often recovered at an archaeological site, provide a unique opportunity for a focused analysis on pre-contact Alaskan coastal cultural adaptations.

Therefore, the objective of this thesis is to evaluate incisal dental microwear patterns of the Ipiutak and Tigara skeletal sample to test hypotheses concerning the relationship between diet and dental microwear. Additionally, distinct male and female activities in both populations will be examined in order to discuss the consequences of the gender-based division of labor on dental biology.
Figure 1.2 Point Hope spit. Modified from Larsen and Rainey 1948.
CHAPTER II

LITERATURE REVIEW

North American Arctic Archaeology

In order to facilitate discussion on the Point Hope archaeological sites, it is necessary to provide a basic background on North American arctic archaeology. The North American arctic ranges approximately 6,000 miles from Greenland in the east, through Canada and Alaska, to the northeast coast of Siberia in the west (see Figure 2.1, Collins 1984). The first Europeans saw the Alaskan arctic coast Eskimos in 1741, and the first Arctic archaeological excavation was undertaken in 1927 in Greenland (Collins 1984).

A temperature trace was kept at Point Hope from 1888-1904; the coldest temperature recorded was -48°F and the warmest peaked at 97°F (Larsen and Rainey 1948). The windiest places in the arctic are those on the coast, and with Point Hope’s elevation at sea level, there are no barriers to the cold Siberian wind (Stager and McSkimming 1984). Additionally, ice packs along the shore can cover surfaces extending as much as ten miles out to sea (Stager and McSkimming 1984). Due to wind and sea currents, Point Hope’s southern coast is most affected by ice packing, with an average height of 30 to 40 feet and width of 50 to 100 feet (Larsen and Rainey 1948). Challenges to arctic archaeology include broadly distributed sites, expensive and
Figure 2.1 North American arctic. Modified from Giddings 1967.
problematic transportation to those sites, rural living conditions, short field seasons, and permafrost (Dekin 1978). Permafrost hinders excavation; as one layer is removed, the layer underneath begins to melt. As water accumulates, it causes sidewall distortions or crumbling (Dekin 1978). Regardless, permafrost also is a huge advantage to arctic archaeology, as it can be an excellent preservative. Under the right conditions, organic cultural objects will be well preserved if frozen shortly after deposition (Dekin 1978; Rainey 1971). The objects typically preserved might include baskets, clothing, bark

Figure 2.2 Arctic cultural traditions. Modified from Oswalt 1999; Bandi 1969; Dumond 1977.
containers, food remains, bone and antler implements, and human burials (Dekin 1978; Rainey 1971). One excellent example of this preservation is the mummies of Qilakitsoq, Greenland (Ammitzbøll et al. 1991a).

Therkel Mathiassen performed the first archaeological excavation in Greenland in 1927, resulting in the identification of one of three commonly accepted archaeological culture areas, the Thule culture (see Figure 2.2; Collins 1984). The Thule culture area encompassed St. Lawrence Island, the northern Alaskan and Canadian coasts, and eastern Greenland (Larsen 1961). Coastal cultures relied primarily on sea-mammal hunting, interspersed with land mammal hunting when available (Collins 1984).

The second accepted prehistoric culture, the Dorset, was located in the areas around Hudson Bay, northern Greenland, and Newfoundland (see Figure 2.2; Collins 1984; Larsen 1961). The subsistence patterns associated with this culture include an increase in sea-mammal hunting with less reliance on land mammals, such as caribou (Dumond 1977). Evidence of the third and last prehistoric culture, the Kachemak Bay culture, was concentrated in southwestern Alaska and the Aleutian Islands (Larsen 1961). Midden excavations indicate a reliance on sea-mammals and fish, including cod, greenling, and halibut (Dumond 1977). Land mammals, such as caribou and bear, occasionally reinforced this diet (Dumond 1977).

According to Larsen (1961), the Thule and Dorset archaeological cultures exhibit three broad culture horizons. The first horizon, the Proto-Eskimo, is called the Denbigh Flint horizon. Cultural material includes flint tools such as drills, knives, and scrapers, carved ivory implements, and harpoon heads (Bandi 1969). The second horizon, the
Paleo-Eskimo, is found in two different forms: one including pottery, and one without
(Larsen 1961). Cultures with pottery include the Norton, Near Ipiutak, and Choris, and
those without pottery are the Ipiutak and Dorset (Larsen 1961). The latest horizon is the
Neo-Eskimo and includes the Okvik and Inugsuk cultures. These cultures include
archaeological artifacts such as developed harpoon heads, snow goggles with round
openings (as opposed to the more common slit opening), and carved wooden figurines
(Bandi 1969).

When the archaeological sites of Point Hope were initially excavated, Larsen and
Rainey (1948) recognized that Tigara and Jabbertown were occupied during the late
prehistoric and early modern periods. However, the discovery of flaked flint tools
instead of rubbed slate tools at the Ipiutak site created confusion as to its position in
Eskimo culture (Rainey 1971). Additionally, the Ipiutak carved ivory objects closely
resembled those of the oldest culture known at the time, the Okvik (Rainey 1971). The
culture found at Ipiutak is now called the Ipiutak culture, with influences as far back as
the Denbigh Flint complex (Anderson 1984; Collins 1984).

Point Hope Site Description

The archaeological excavations at Point Hope began in 1939 and were conducted
by Larsen and Rainey as a joint American-Danish expedition. Their primary objective
was to locate the earliest Eskimo site, which they hypothesized would be found in the
west, closest to Siberia. They agreed that Point Hope, from preceding descriptions,
would merit study. Arriving in July of 1939, they found Eskimo women and children
excavating the site and selling the artifacts, a practice begun several decades earlier with
the increased number of trading ships in the area (Larsen and Rainey 1948). This trade
industry temporarily hindered Larsen, Rainey, and their crew from excavating, as the
council of village elders had to be persuaded regarding the benefits of scientific
archaeological excavation (Larsen and Rainey 1948).

With permission granted, two archaeological sites were excavated: Tigara and
Jabbertown (Rainey 1971). Tigara is situated 600 yards from the Arctic Ocean coast, and
Jabbertown lies approximately five miles east of Tigara (see Figure 1.2; Rainey 1947).
During the first field season, the Ipiutak site was found about one mile north of Tigara
(Rainey 1971).

The Ipiutak site dramatically changed arctic archaeology, as it did not correspond
to any other recognized arctic cultural tradition (Collins 1984). The Ipiutak site yielded
more than 600 housing units, arranged in rows, each in close proximity to one another
(Rainey 1971). The three-year excavation of 72 house units indicated that no units were
built over another and the house layout and material artifacts recovered were of similar
form throughout the site (Rainey 1971). Larsen and Rainey interpreted the house
distribution and artifact content as evidence for a continuous and contemporaneous
occupation. They also suggested that Ipiutak was the largest arctic settlement then
known (Larsen and Rainey 1948). Although this remained the prevailing hypothesis, it
has been recently disputed (Mason 2005).

Ipiutak houses were generally square in shape with rounded corners (see Figure
2.3). They were semi-subterranean, with an average depth of 50 centimeters (Larsen and
Rainey 1948). The superstructure was most likely made from driftwood logs and willow branches; however, the poor state of preservation hinders this hypothesis from being accurately tested (Larsen and Rainey 1948). Ipiutak houses possessed a side

Figure 2.3 General Ipiutak house structure. Modified from Larsen and Rainey (1948).
entrance, a four-post roof supporting system, and central fireplace, common features of prehistoric Alaskan houses (Larsen and Rainey 1948). After excavating several housing units, Larsen and Rainey examined the possible location of burials associated with the site.

Local Point Hope community members were hired to help locate and excavate these graves, with a monetary reward for each successful find (Rainey 1971). The Ipiutak burial site was located in 1940, 560 meters southeast of the Ipiutak village (Larsen and Rainey 1948). A total of 138 Ipiutak burials\(^1\) were found below the surface in three different contexts: coffin, midden-like, or row burials (Larsen and Rainey 1948). The 59 coffin burials were made from driftwood logs in a rectangular shape, with a bottom, four sides, and a cover. The majority of the coffin burials had one person, but six contained two people and two had three people (Larsen and Rainey 1948). Furthermore, of the thirty-six coffin graves with cultural material, none had more than just a few objects\(^2\), but some of the artifacts recovered included carved ivory with jet inlay (to mimic eyes), ivory masks, nose plugs, and mouth covers (Larsen and Rainey 1948; Rainey 1971).

Two types of burials were shallow, suggesting they were originally surface burials. Of the two types, the more frequent midden-like consisted of shallow

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\(^1\) The total number of Ipiutak burials is problematic due to instances of commingling. See Newton, J.I.M. (2002) for further information.

\(^2\) The lack of burial objects may be interpreted by some as evidence of looting or pot hunting. Upon arrival to Point Hope, Larsen and Rainey (1948) found local Point Hope women and children excavating the Tigara village house to locate items that coast guard and trading ship crews could buy. However, this is associated with the Tigara village remains and according to Larsen and Rainey’s 1948 site report, the Ipiutak cemetery had not been identified or disturbed.
assemblages of incomplete human and animal bones, antler, ivory, flint, and decaying wood (Larsen and Rainey 1948). Row burials were virtually exclusive to the east end of the cemetery near Jabbertown, and were compiled, “as if carefully laid out at one time” (Rainey 1971:12). Artifacts found with both types of surface burials included ivory openwork carvings unique to Ipiutak culture, carved rods, chains, ornamental points, and daggers (Larsen and Rainey 1948).

Over 10,000 cultural artifacts associated with the Ipiutak site were recovered during the three-year investigation. Although this group lived on the coast, only 324 harpoon parts were recovered, but 2240 artifacts related to archery were found (Rainey 1971). Thus, Larsen and Rainey (1948) suggested that the Ipiutak culture was more heavily reliant on a land-mammal diet than sea-mammal. Current research has questioned this hypothesis and instead suggested the large amount of arrowheads found could be attributed to warfare, not land-mammal hunting (Mason 2005). Additionally, antler projectile points, flint blades, rounded ivory points, ivory and antler engraving tools and bird bone needles, awls, antler flint flakers, snow goggles and birch bark vessels were also part of the material assemblage.

The Tigara tradition differs from the Ipiutak culture in several ways. Housing units were similar in construction to the Ipiutak, being semi-subterranean and made of driftwood logs, but both logs and whalebone were used as buttresses in the Tigara houses (Larsen and Rainey 1948; Rainey 1947). Material artifacts found in the housing units include slate harpoon blades, ice picks, flint projectile points, whalebone sled shoes, slate knives and ulu blades, and potsherds (Larsen and Rainey 1948).
The nearly 400 Tigara burials excavated north and east of the village are considerably different from the Ipiutak in that they are almost uniform in appearance. Burials were found in two similar contexts: coffin and wood /whalebone frame (Larsen and Rainey 1948). Each grave contained one skeleton in supine position with the head facing west. Leg positions varied anywhere from being slightly bent, to completely flexed upon the chest (Larsen and Rainey 1948). Cultural material in the graves was sparse, but included flint, antler, and ivory projectile points and harpoon heads, ground slate ulu blades, clay lamps and pots, ivory snow goggles, and bird bone needles (Larsen and Rainey 1948).

Ethnographic Review

The foremost question pertaining to the Ipiutak and Tigara archaeological sites regards the subsistence strategies of both groups. According to Larsen and Rainey (1948), the Ipiutak were a seasonal group, relying primarily upon caribou and secondly on sea mammals, not including whales. On the other hand, the Tigara are believed to have relied solely on sea mammals, with whales taking precedence (Larsen and Rainey 1948). One must question whether this interpretation can be supported through other lines of evidence.

One way to answer this question is by looking at the skeletal and dental remains. My research investigates whether dental remains, specifically incisal dental microwear, can offer additional evidence. However, ethnographically, anterior teeth are used by Eskimo and Inuit communities in behaviors other than chewing food, called
paramasticatory behaviors. Thus, it is imperative to compare the sexual division of labor between coastal (Taraeumiut) and interior (Nunamiut) Alaskan Eskimo groups to determine if differences exist. If differences exist, this may help to distinguish microwear signatures between the two Point Hope communities.

Ethnographic information on traditional activities for indigenous peoples from coastal Alaskan (Taraeumiut) areas is largely from European and American explorers from the 19th century. They suggest that women were primarily responsible for all aspects of childcare and domestic tasks (Andrews 1939; Giffen 1930; Ray 1885; Simpson 1875). Particularly, women were recorded carrying and caring for both male and female children (Andrews 1939; Giffen 1930; Simpson 1875). Domestic tasks included cooking reindeer and seal meat; preparing, scraping, dressing and tanning skins; sewing clothing and boots both from caribou and seal skins; housekeeping; caring for dogs and maintaining the water supply and general supplies of the household (Andrews 1930; Foote 1992; Giffen 1930; Ray 1885; Simpson 1875). They also were recorded bringing in their husband’s kill, such as seal carcasses (Simpson 1875).

Men were recorded performing tasks associated with hunting (Andrews 1939; Giffen 1930; Ray 1885; Simpson 1875). Particularly, they were responsible for hunting whales and seals; setting nets for seals; catching small fish; flintknapping; manufacturing and maintaining subsistence technology used at other times of the year and removing and stretching animal skins (Andrews 1939; Giffen 1930; Ray 1885; Simpson 1875). Generally speaking, women provided the foundation for key subsistence activities.
For the interior (Nunamiut) groups existing on land mammals, a similar sexual division of labor was recorded, although slight variations inevitably occurred. Women were recorded as performing the majority of household duties, but also participated in aspects of hunting (Giddings 1967; Gubser 1965; Oswalt 1967). Specifically, women cared for children; manufactured pottery; collected firewood, berries, roots, ice, snow, water, bark and plants; helped in the caribou hunts; transported caribou carcasses back to camp; distributed caribou meat among the other families; fished, cleaned, and dried salmon; constructed moss houses; handled and cared for the dogs; made toys for the children; cooked and above all else, manufactured clothing by sewing (Giddings 1967; Gubser 1965; Oswalt 1967). In fact, “the most important ability for her to develop is her skill as a seamstress” (Gubser 1965:111).

In the Nunamiut community, a woman’s appeal was based upon her ability as a seamstress. She had to prepare skins and sinew thread and construct clothing and boots. The main difference between the coastal and interior groups in this aspect is the material utilized. The Nunamiut community used primarily caribou skins, but used other land mammals such as mountain sheep, gray wolves, foxes, mink and grizzly and black bear. While some Nunamiut families had knowledge of sea mammals due to trading relations with the coastal communities, they were not extensively used in the interior (Gubser 1965).

“For the Nunamiut, to become a man is to become a hunter” (Gubser 1965:109). Similarly to the Taraeumiut, men were hunters and craftsmen, but relied, above all, on caribou. They shot and butchered the caribou before bringing it back home (Giddings
1967; Gubser 1965). They also were recorded killing mountain sheep, fox and wolf (Giddings 1967; Oswalt 1967). They set traps and manufactured tools, weapons, bow drills, bows and arrows, snowshoes, dog harnesses, meat racks, sleds and fish traps and nets (Gubser 1965). Yet, it appears as if Nunamiut women performed a broader range of tasks compared to both Nunamiut men and Taraeumiut men and women.

It is important to note a few significant details surrounding the labor differences between the coastal Taraeumiut and interior Nunamiut communities. First, although the Taraeumiut are recorded using primarily sea mammals and the Nunamiut using caribou, one should not reach the conclusion that either group did not obtain skins from each other through trade. In fact, several sources cited the importance of trade networks between these two groups and an annual trading expedition to Point Barrow or Kotzebue was always on the Nunamiut schedule (Giddings 1967; Gubser 1965; Oswalt 1967). There, the Taraeumiut could obtain caribou skins, a material known to be the best for clothing. Although the Taraeumiut could secure caribou themselves, weather and migration patterns often thwarted these efforts (Gerlach 1989; Oswalt 1967). For the Nunamiut, getting sea mammal oil, seal skin for weatherproof boots and ivory for tools were reasons for the journey (Oswalt 1967). These trade partnerships were so important that they often were exploited during lean times (Gubser 1965).

A second important difference is in the materials used to make hunting and other household implements and their archaeological contexts. The Taraeumiut relied heavily on ivory, flint and ground slate for their implements (Giddings 1967). Many carved ivory objects were recovered during the field seasons at Point Hope. On the other hand, the
Nunamiut used sandstone, gray and black chert and especially local jade (Giddings 1967). It is important to note that carved ivory objects associated with coastal hunting were recovered during archaeological research at the Ekseavik site of interior Alaska, but no jade objects were found at Point Hope, even though coastal groups sought after it when trading with inland groups.

A third and most obvious difference is the type of animals exploited. The Taraeumiut relied primarily on sea mammals such as seal, walrus and whale while the Nunamiut relied chiefly on land mammals (mountain sheep, fox and caribou) and fish, especially salmon. In summary, it seems as though the sexual divisions of labor of the coastal and interior Alaskan Eskimo communities were similar, but different materials and animals were utilized according to availability and integral trade networks.

Dental Research on Point Hope

With a general overview of the ethnographic information and original excavation it is possible to summarize the dental research on these two populations. Although Raymond Costa conducted his Ph.D. dissertation research and published three successive articles on the Point Hope dental remains (Costa 1977, 1980a, 1980b, 1982), there has been only modest bioarchaeological work on the Point Hope collection since their excavation between 1939-1941.

In his dissertation, Costa (1977) discussed the importance of studying the dental lesions of past and present cultures without modern dentistry in order to compare them
with early hominids. Costa (1977) looked at many different dental dimensions of the Point Hope population, including the formation of calculus deposits, the number of carious lesions and abscesses, dental wear, crown height, alveolar recession, and periodontal disease.

Calculus (the precursor to which is plaque) was found to decrease with age; however, Costa attributes this to the large antemortem tooth loss with aging (Costa 1977, 1980b). The number of carious lesions and abscesses were low in the Point Hope sample. Although the number of carious lesions generally remains the same in all ages, the number of abscesses increases with age. Costa attributes this phenomenon to either worsening of existing carious lesions or heavy dental wear and trauma (Costa 1977, 1980a).

The dental wear pattern showed that although both sexes have a significant amount of dental wear, women initially show less than men, but as age increases, women overall display more wear (Costa 1977). Costa (1977) attributes this pattern to women using their teeth in paramasticatory fashion for cultural practices, such as clamping and holding animal hides. Clinical crown height, the measurement from the alveolar margin to the tooth crown, was seen to decrease as wear increases in both sexes. Additionally, alveolar bone recession increases with age in both sexes, but becomes exceedingly problematic at approximately 40 years of age (Costa 1977). Lastly, periodontal disease increased with age in both Point Hope populations, but the Tigara group had more acute periodontal disease than the Ipiutak (Costa 1982). Tigara females showed more periodontal disease than men, but in contrast, the Ipiutak males showed more periodontal
disease than the females (Costa 1982). Costa (1982) hypothesized that both the overall mild and localized, severe forms of periodontal disease in these two populations could be due to a high fat and protein diet. He proposed this in order to establish a foundation concerning periodontal disease in societies where high sugar and carbohydrate diets did not exist (Costa 1982).

Another important study has used the Ipiutak and Tigara collections for comparison with fossil hominins, specifically, Neandertals. Several studies have suggested that Neandertal populations showed a high level of linear enamel hypoplasias, (LEH) which are broad signs of physiological stress. Guatelli-Steinberg et al. (2004) wanted to compare the high level of LEH in Neandertals found in these studies with a modern foraging group, the Point Hope skeletal sample, to determine any similarities. Both populations showed approximately the same percentage of systemic LEH (Neandertals, 38% and the Inuit, 33%) (Guatelli-Steinberg et al. 2004). Based on LEH incidence, Neandertals were not more physiologically stressed than the Point Hope skeletal sample (Guatelli-Steinberg et al. 2004).

Lastly, Sireen El-Zaatari (2005), has completed an occlusal molar microwear study of the two prehistoric Point Hope communities. In her research, El-Zaatari (2005) examined a “Phase II” facet (crushing/grinding) and found that the Tigara molar samples had more dental microwear features than the Ipiutak (2005). Specifically, the Tigara samples had a higher pitting incidence than that of their Ipiutak counterparts (2005). El-Zaatari attributes this to more sand in the Tigara diet due to possible differences in food preparation. She also states that this difference in molar microwear signatures helps to
confirm Larsen and Rainey’s archaeological interpretation that the Ipiutak and Tigara communities relied on different dietary practices (2005).

Approaches to Dental Microwear Analysis

There are generally six reasons for the analysis of dental microwear: to determine jaw movement patterns, tooth wear agents, rates of tooth wear, diet and wear correlations, reconstruction of diet using archaeological specimens, and as evidence for handedness or tool use in food processing (Walker and Teaford 1989). Dental microwear analysis using the scanning electron microscope (SEM) began in the 1960s due to the instrument’s better resolving power and depth of field (Walker and Teaford 1989). Since this time, many researchers have utilized different techniques, including the use of scanning confocal and low-magnification stereoscopy (Scott et al. 2005; see Hillson (1996) for review).

One of the most important aspects of dental microwear analysis is the methodology. As outlined by Teaford (1994), past research has involved microscopic analysis of high-quality casts of teeth, created through the use of impression materials that either produce a thin varnish peel or a premixed base and catalyst that is applied directly to the teeth. The mold is considered a negative of the original specimen. If a positive replica of the original teeth is preferred, then a high-resolution cast is made. Once the peel, cast, or specimen itself is acquired, the use of SEM is employed to locate and measure the defects found, including pits, scratches, and polishes (Teaford 1994).
Some researchers, however, have noted difficulties with this procedure. For example, microwear measurements can be erroneous in relation to working distance, contrast differences, and the angle of the specimen (Teaford 1994). In addition, microwear analysis can be time consuming, with each specimen taking hours to complete (Teaford 1994). Additionally, innovative techniques involving the use of confocal microscopes to produce surface topography diagrams of enamel surfaces have nearly replaced the use of SEM. In fact, some dental anthropologists now consider SEM microwear studies to be obsolete (Dr. Peter Ungar, personal communication).

Initial studies of diet-related dental microwear examined nonhuman primates. These studies indicated that the terrestrial monkey dentition had more striations than the arboreal monkeys (Ungar 2002). It appears that the type of diet (siliceous material in the food), feeding surface, and mechanical load of food breakdown all play a role in microwear formation (ibid). Various studies throughout the last 20 years included comparative microwear studies using extant primates with known diet and microwear analysis involving closely related monkeys (Teaford 1988). Other studies included associations between extant primate diet and microwear in order to deduce diet in extinct primates and incisor microwear in relation to diet (El-Zaatari et al. 2005; Rafferty et al. 2002; Teaford and Walker 1984 for primate studies and Ungar 1990, 1994, 1996; Ungar and Grine 1991; Ungar and Spencer 1999 for incisor studies). Additional studies have provided insights into hominid diet through dental microwear analysis (Gordon 1984; Lalueza et al. 1996; Ryan and Johanson 1988; Ungar and Spencer 1999).
In addition, microwear defects undergo a turnover rate; that is, while old defects heal, new ones are produced. Some researchers have suggested that seasonal diets can be detected in accordance with this phenomenon (Walker et al. 1978). Others note that seasonal changes can only be seen in specific environments (Walker and Teaford 1989). Regardless, this turnover rate still only leads to the observation of microwear formations of the past few months (Walker and Teaford 1989). In order to balance for this trend, a large study sample must be utilized in order to record the variability within the species (Walker and Teaford 1989).

Approaches to Cultural Impact on Dentition

Biology often leaves its marks on an individual’s skeleton and dentition, but culture is a noteworthy variable in this equation as well. The effect of culture upon biology is an essential facet for any researcher, particularly in relation to dentition. Teaford (1994) describes the use of teeth in behaviors other than food processing as parafunctions, and explains three of them in regards to non-human primates. The first parafunction is grooming. Those primates that use their anterior teeth (incisors and canines) for grooming will present medially-situated microwear striations in SEM studies (Teaford 1994). The second parafunction is chewing or gnawing on items other than food. One study suggests that the chimpanzee production of termite probes creates specifically oriented microwear scratches on their incisors (Teaford 1994). The last parafunction is tooth-grinding. Research has been presented in which tooth-grinding was identified with heavy microwear scratching, pits, and temporomandibular joint syndrome
Although these last studies are considered controversial, further examination may resolve problematic methods.

How can this information be coupled with human cultural adaptations? Studies of the Qilakitsoq mummies, eight Inuit individuals (six women and two children) buried together on the northwestern coast of Greenland can provide an example (Hart Hansen et al. 1989). The radiocarbon dating indicates they date to AD 1475, making them the oldest known arctic mummies (Hart Hansen et al. 1989).

The Qilakitsoq dentitions revealed quite a bit about their way of life. Of the eight mummies, dental conditions of four (mummies 2, 5, 7, and 8) could be studied. Mummy 2 was determined to be a male child approximately four years of age and did not display antemortem tooth loss or significant dental wear\(^3\) (Pedersen and Jakobsen 1989). Mummy 7 was a female between the ages of 18-21 and the dentition showed slight wear and no carious lesions (Pedersen and Jakobsen 1989). Mummies 5 and 8, both female were determined to be approximately 50 years of age and both displayed extensive anterior tooth wear (Pedersen and Jakobsen 1989). Mummy 5 showed a massive amount of dental attrition, especially on the mandibular incisors. The mandibular incisors had no remaining enamel and the maxillary enamel was nearly gone (Pedersen and Jakobsen 1989). Mummy 8 lost three incisors prior to death, and the 23 remaining teeth demonstrated widespread enamel chipping and wear (Pedersen and Jakobsen 1989).

There are several plausible explanations for the extensive dental attrition and loss. One is animal hide preparation. Ethnographically, female Eskimo populations have been

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\(^3\) Interestingly enough, this mummy displayed symptoms of Down's Syndrome. See Pedersen and Jakobsen (1989) for further details.
recorded using their teeth as a third hand when preparing and scraping animal hides (Ammitzbøll et al. 1991a,b; Foote 1992; Geffen 1930). Women clamped down on the skin (usually seal or caribou skin) with their anterior teeth in order to scrape the fat off the skin using their traditional knives, known as ulus. Additionally, female Eskimos have been documented scraping skins by using their lower incisors and chewing the edges to prepare it for sewing (Ammitzbøll et al. 1991b; Foote 1992; Giffen 1930). These practices would appear as “numerous fine, parallel scratches” in dental microwear analysis of occlusal surfaces (Pedersen and Jakobsen 1989:123).

Another possible explanation for the dental damage, also related to sewing, involves the preparation of sinew threads. The practice begins with the slicing of thick sinew material with the ulu. Females would roll these slices across the cheek, then rub the sinew back and forth between the incisors in order to make it soft and moist (Ammitzbøll et al. 1991a,b; Foote 1992; Giffen 1930; Pedersen and Jakobsen 1989). This practice eventually created sinew grooves across the incisors; however, many women lost their incisors antemortem, most likely from hide preparation, forcing them to use their canines and premolars (Pedersen and Jakobsen 1989).

Although I have described here several examples of female paramasticatory behaviors, men also were documented performing similar activities. Among these behaviors include towing seals, untangling traces and softening lines (Giffen 1930). One reference even referred to an Alaskan Eskimo man opening an oil drum with his teeth (Chance 1990).
To summarize, arctic archaeology presents its own set of challenges, from harsh weather conditions to artifact preservation; however, the inferences that can be made from its research provide integral information concerning the survival practices utilized by prehistoric arctic foragers. Specifically, the archaeological excavations at Point Hope, Alaska, provided anthropologists with further data regarding subsistence strategies, but also raised many more questions.

Another central question concerns the Ipiutak and Tigara dietary practices and subsistence strategies. While the archaeological data are interpreted in one way, the human skeletal remains can allow independent testing of hypotheses derived from archaeological analysis. Therefore, if Larsen and Rainey’s 1948 archaeological interpretations were correct, one would expect to find incisal dental microwear signatures within each group congruent with either land-based or coastal-based diet and paramasticatory behaviors.

Thus, realizing the effect of cultural systems upon oral biology will be a crucial component in this project. Understanding the technical aspects of microwear analysis is only half the battle. As the preceding discussion makes clear, cultural practices must be understood in order to obtain accurate and functional scientific data.
CHAPTER III

METHODOLOGY

Sample Size and Composition

Due to the laborious dental microwear methods, a total sample size of 20 individuals, out of approximately 500 crania in the collection, was initially selected for this study. The sample was sub-divided into equal groups of Ipiutak and Tigara males and females (n=5 for each of the four subgroups). These individuals, housed at the American Museum of Natural History (AMNH) in New York City, were sexed in accordance with standard osteological techniques (Buikstra and Ubelaker 1994). See Table 3.1 for specific information.

Although the sample size for this particular study equals 20 individuals, 120 individuals, comprised of equal Ipiutak and Tigara males and females, were sexed and 95 mandibular dentitions were molded and cast. This allows for more extensive studies of Point Hope dental microwear to occur in the future.

The 20 individuals selected for this research were chosen because they represented the best-preserved mandibular incisors out of the total 95 molded. First, they had all four mandibular incisors, providing the best availability for microscopic research. Second, they had enough enamel for dental microwear research. A main problem with this kind of research on a population such as the Point Hope communities is extensive attrition and tooth loss. Enamel, when preserved at all, is often damaged, cracked and
only present along the edge of the tooth. Consequently, although 95 casts were produced, many of them will not provide adequate dental microwear data due to the aforementioned problems.

While performing my dental microwear counts, I discovered one specimen with an extraordinarily high incidence of feature counts. Consequently, this specimen, Ipiutak 99.1/196, a male, was removed from final analysis. Each sample group still had 5 individuals with the exception of the Ipiutak males, which had 4 individuals.

<table>
<thead>
<tr>
<th>AMNH</th>
<th>Ipiutak</th>
<th>99.1/75-A</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/80</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/83-A</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/88</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/89-B</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/92</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/95</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/105</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/181</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Ipiutak</td>
<td>99.1/196</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/234</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/237</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/268</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/283</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/300</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/304</td>
<td>Female</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/319</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/330-A</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/441</td>
<td>Male</td>
</tr>
<tr>
<td>AMNH</td>
<td>Tigara</td>
<td>99.1/464</td>
<td>Female</td>
</tr>
</tbody>
</table>

Table 3.1 Ipiutak and Tigara specimens used.
Molding and Casting

I molded the dentition at the AMNH during May of 2005. I cleaned the mandibular incisors, both central and lateral, with an undiluted solution of acetone and a soft toothbrush prior to molding. When present, canines and premolars were also cleaned and molded. The molding material used was President’s Jet Plus, regular body (Coltène-Whaledent, Hudson, MA) a standard, silicone-based vinyl polysiloxane. The approximate set time for the President’s Jet Plus is five minutes. After the polysiloxane was applied to the cleaned mandibular dentition, I waited three minutes before pressing a cake spatula onto the occlusal surfaces. This allowed air bubbles to be eliminated from the mold and also assisted in capturing as much dental microwear as possible. After approximately ten minutes, I gently removed the molds from the teeth, placed each mold in a labeled paper bag, and removed any remaining President’s Jet Plus from the mandible. This procedure produced 95 molds comprised of 19 Ipiutak females, 16 Ipiutak males, 30 Tigara females and 30 Tigara males.

High-resolution epoxy resin casts were made during the summer and fall of 2005. These casts were made from an industrial marine, automotive and aircraft epoxy resin (Eastpointe Fiberglass Sales, Inc, Eastpointe, MI). A 4:1 mixture of F-82 Super Epoxy resin and TP-41 epoxy hardener was produced for approximately five casts at a time. In addition, white epoxy pigment (#ED-1018, Plasticolors, Ashtabula, OH) was added to
this mixture (2% based on volume) in order to maximize reflectance under an interference and light microscope.

Once the epoxy mixture was produced, it was poured into each dental mold. Each mold was then centrifuged. Medical centrifuges typically operate at too high a speed, causing the epoxy mixture to spill out from the dental mold entirely. Therefore, a heavy-duty line metering machine (Berkley and Company, Spirit Lake, IA), used to measure the amount of fishing line you put on a reel, was modified for use. This machine, commonly found in sporting goods stores, was ideal for this project as it allowed me to control the spinning speed. A few molds with the epoxy mixture were placed in a small plastic container and secured where the spool of the fishing reel would be placed before it was threaded. The molds were then spun for approximately one minute to remove air bubbles. After the 95 casts were produced, 20 were selected for microscopic examination.

Microscopy Techniques

Although scanning electron microscopes (SEM) are most often used in this type of study, researchers are turning to other microscopes, including surface topography microscopes, for refined microwear data. This study utilized a SMZ-U stereomicroscope from Nikon (Tokyo, Japan). The benefit of a light microscope is its freedom from strict measurements (Semprebon et al. 2004). Instead, dental microwear features are identified
through their light refractiveness and are more quickly documented (Semprebon et al. 2004).

Once the 20 casts were selected, they were evaluated under the light microscope using a fiber optic light source. It was determined that gold sputtering the white casts would aid in the appearance of dental microwear features. Consequently, these casts were sputtered with approximately 200 Å of gold using an SEM autocoating unit (Polaron Equipment, Ltd.). I recommend gold sputtering any casts prior to any future light microscopy work in dental microwear, as it greatly added to feature appearance. Although there is a slight difference in tilt, see Figure 3.1 for a comparison of the cast before and after gold sputtering.

![Figure 3.1 Tigara 441, male, occlusal surface of the central right incisor before and after gold sputtering.](image-url)
A TIFF-formatted, digitized photograph was taken of each specimen using the MetaMorph computer software (Molecular Devices Corp, Downingtown, PA). Measurements and analysis of feature lengths and widths were collected also by using the MetaMorph image analysis software.

Dental Microwear Descriptions and Scoring

Due to the extensive occlusal wear, the labial, incisal and lingual aspects of the central mandibular incisors were considered for this study (Ungar 1994; See Figure 3.2). This ensured that the most pristine enamel surfaces be utilized (Dr. Peter Ungar, personal communication). Additionally, it is imperative to describe the characteristics of each microwear feature, as to facilitate reproducible and comparable results. Table 3.2 provides a description of each feature considered in this study while Figure 3.3 provides pictures.

The dental microwear scoring proceeded as follows: the TIFF image was changed to a BMP format to allow it to be downloaded into a semi-automated image analysis software program called Microware 4.02 (Dr. Peter Ungar, Fayetteville, AR). The software allows for a grid to be placed on top of the image. Each microwear feature was counted in each box of the grid, producing a total number of microwear features per digital image.
<table>
<thead>
<tr>
<th>Type of Dental Microwear Feature</th>
<th>Description of Microwear Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Scratch</td>
<td>Must possess a minimum 4:1 length to width ratio, very narrow, straight, shiny and white under the light microscope.</td>
</tr>
<tr>
<td>Hypercoarse Scratch</td>
<td>Also must possess a minimum 4:1 length to width ratio, but are deeper and wider than fine scratches. These appear somewhat dark under the light microscope.</td>
</tr>
<tr>
<td>Pit</td>
<td>Less than a 4:1 length to width ratio. Appear dark under the light microscope due to low refractivity.</td>
</tr>
</tbody>
</table>

Table 3.2 Dental microwear features and their descriptions.

Feature counts were recorded three times over a period of three days. The means and standard deviations of each individual were computed using MS Excel. Fine scratches and pits were assigned different sizes: small, medium, and large. Due to their relatively low expression, hypercoarse scratches had small and large categories.

Placing features into categories allowed me to relax the often exhaustive measurement time taken during microwear analysis. It has been documented that one photograph may take several hours to complete (Semprebon et al. 2004). Moreover, I found that most features, especially fine scratches, extended further than the surface area analyzed. Because of this, providing exact measurement lengths would have been grossly underestimated and imprecise. Thus, the use of these arbitrary groups allows the needed flexibility in measurement data, but still provides useful information. Table 3.3 provides information concerning the boundaries of these arbitrary groups.
Figure 3.2 Possible enamel surfaces to be sampled.
I: Labial surface; II: Occlusal surface; III: Lingual surface
Modified from Ungar (1994).
<table>
<thead>
<tr>
<th>Type of Dental Microwear Feature</th>
<th>Arbitrary Size Group (based on length in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Scratch</td>
<td>Small: 0.01-0.049</td>
</tr>
<tr>
<td></td>
<td>Medium: 0.05-0.099</td>
</tr>
<tr>
<td></td>
<td>Large: 0.10-greater [0.70]</td>
</tr>
<tr>
<td>Hypercoarse Scratch</td>
<td>Small: 0.01-0.29</td>
</tr>
<tr>
<td></td>
<td>Large: 0.30-greater [0.80]</td>
</tr>
<tr>
<td>Pit</td>
<td>Small: 0.01-0.029</td>
</tr>
<tr>
<td></td>
<td>Medium: 0.03-0.059</td>
</tr>
<tr>
<td></td>
<td>Large: 0.06-greater [0.20]</td>
</tr>
</tbody>
</table>

Table 3.3 Dental microwear features and their associated arbitrary size group.

Statistical Analysis

There are several aspects of this project, but one of the most important is the statistical analysis. The proper use of statistics is integral in order to arrive at reliable conclusions. Most dental microwear studies utilize summary statistics and analysis of variance (ANOVA). Descriptive statistics are imperative to inform the reader of the central tendency and dispersion in such variables as number of pits, fine scratches and hypercoarse scratches. Using box plots for this information will also help to illustrate the many numbers often involved.

In order to assess whether the mean values of the Ipiutak and Tigara dental microwear features are significantly different and scientifically important, ANOVA tests will be performed. This parametric test was selected for several reasons. It was selected primarily for its ability to simultaneously compare several means of normally distributed, independent variables. Second, we are using a separate sample from each population.
Using ANOVA allow me to assess whether any group was exposed to different treatments (in this case, different diets and paramasticatory behaviors). Third, they provide more robust conclusions in the chance of a skewed distribution. Lastly, using ANOVA greatly reduced the possibility of a Type I error, a phenomenon that can occur with multiple two-tailed t tests (Dr. Charles Hilton, personal communication).

The descriptive statistics were calculated using the data analysis feature of Excel. Each individual’s mean for a particular microwear defect (i.e. small pits for individual 99.1/75-A) was combined with other individuals’ means for the same particular defect in order to calculate a group mean. This group mean could be any of the following groups: Ipiutak (n = 9), Tigara (n = 10), Females (n = 10), Males (n = 9), Ipiutak females (n = 5), Ipiutak males (n = 4), Tigara females (n = 5) and Tigara males (n = 5). Therefore, only an individual’s mean was used to calculate any of the group means.

The C_v, coefficient of variation, was calculated in order to give a relative measure of data dispersion compared to the mean. When the C_v is large/small compared to the mean, the amount of variation is large/small. The equation for the coefficient of variation the standard deviation divided by the mean, multiplied by 100. Small sample sizes must be corrected for by using the equation: C_v(1+ 1/4n).

The ANOVA tests and box plots were completed using statistics software SPSS 11.0. If the p value was greater than the critical value of 0.05, then the difference between the means was not significant. On the other hand, if the p value was less than the critical value of 0.05, it represented a significant difference.
Figure 3.3 Examples of dental microwear features

Ipiutak 83-A, Female, Lateral Right Incisor
Hypercoarse scratch

Ipiutak 89-B, Male, Central Left Incisor
Various size pits

Tigara 441, Male, Central Right Incisor
Fine scratches
Hypotheses

Mandibular incisor microwear data collected from the Ipiutak and Tigara skeletal remains from Point Hope, Alaska, will be used to test the following hypotheses:

**H0:** There are no differences between the Ipiutak dental microwear and the Tigara dental microwear.

**H1:** There are differences between the Ipiutak dental microwear and the Tigara dental microwear.

Both coastal groups relied on land and sea mammals. Caribou, most likely obtained from the primary breeding grounds northeast of Point Hope, was necessary for adequate clothing, whether obtained directly through hunting or indirectly through trade (Gerlach 1989). The Ipiutak population utilized both land mammals (caribou) and sea mammals, (seals and walruses), but it is hypothesized the Tigara population relied more on sea mammals including whales (Larsen and Rainey 1948, Rainey 1971). Therefore, a decrease in dental microwear is predicted from the Ipiutak to Tigara populations due to the decrease in caribou reliance and an increase in sea mammal (whale) reliance.

**H0:** There are no dental microwear differences between the Point Hope males and females.

**H1:** There are dental microwear differences between the Point Hope males and females.

According to several historical sources, Eskimo women used their teeth for dressing and softening skins, preparing sinew threads, and extracting blubber (Ammitzbøll et al. 1991b; Foote 1992, Giffen 1930, Pedersen and Jakobsen 1989). Eskimo men are recorded using their teeth for working with hard materials, crushing bird heads, holding
the rope to which a hunted animal is attached, and even opening up an oil drum (Giffen 1930; Chance 1990). Due to distinctions in historical paramasticatory behaviors, it is predicted that the prehistoric Point Hope females will have different types of dental microwear than the prehistoric Point Hope men.

**H0**: There are no dental microwear differences between the Ipiutak and Tigara females.
**H1**: There are dental microwear differences between the Ipiutak and Tigara females.

**H0**: There are no dental microwear differences between the Ipiutak and Tigara males.
**H1**: There are dental microwear differences between the Ipiutak and Tigara males.

These final two hypotheses are challenging, as both groups are prehistoric. In spite of this dilemma, it is predicted the Ipiutak females used their teeth and mouth more often than the Tigara females. Additionally, it is predicted the Ipiutak males used their teeth and mouth more often than the Tigara males. I make these predictions only assuming that paramasticatory behaviors would decrease through time as technology and contact with other groups increased.
CHAPTER IV

RESULTS

Feature Count Data

It is evident that the Point Hope residents relied on paramasticatory functions in their daily life, although there are some distinct differences, which may have resulted from diet. Tables 4.1-4.4 provide mean anterior dental microwear (ADM) data with the standard deviations, while Figure 4.1 displays the data in a bar chart. Figures 4.2 -

When the number of pits, fine scratches and hypercoarse scratches for both the Ipiutak and Tigara groups are summed, the Ipiutak have a greater number. Second, males as a group had more ADM than females. Ipiutak females had slightly more ADM than the Tigara females while the Ipiutak males had considerably more ADM than Tigara males. See below for more specific data.

<table>
<thead>
<tr>
<th>Group</th>
<th>Sample Sizes</th>
<th>Pits</th>
<th>CV</th>
<th>Fine Scratches</th>
<th>CV</th>
<th>Hypercoarse Scratches</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipiutak Females</td>
<td>n = 5</td>
<td>65.6 ± 35.0</td>
<td>56.0</td>
<td>29.0 ± 11.8</td>
<td>42.7</td>
<td>2.6 ± 2.2</td>
<td>88.8</td>
</tr>
<tr>
<td>Ipiutak Males</td>
<td>n = 4</td>
<td>96.9 ± 43.5</td>
<td>47.7</td>
<td>24.1 ± 6.4</td>
<td>28.2</td>
<td>1.8 ± 2.2</td>
<td>133.6</td>
</tr>
<tr>
<td>Tigara Females</td>
<td>n = 5</td>
<td>48.4 ± 21.9</td>
<td>47.5</td>
<td>35.4 ± 19.0</td>
<td>55.4</td>
<td>0.4 ± 0.55</td>
<td>144.4</td>
</tr>
<tr>
<td>Tigara Males</td>
<td>n = 5</td>
<td>68.4 ± 28.8</td>
<td>44.2</td>
<td>46.8 ± 19.3</td>
<td>43.3</td>
<td>0.8 ± 1.3</td>
<td>170.6</td>
</tr>
</tbody>
</table>

Table 4.1 Mean group dental microwear feature counts with standard deviation. See Chapter 3 for an in-depth description of how these figures were calculated. There were no statistically significant differences.
Figure 4.1 Summary chart of mean dental microwear by size and Point Hope sample. Each specific type of dental microwear feature (i.e. pits, fine scratches and hypercoarse scratches) is showcased by size (small, medium and large for the pits and fine scratches and small and large for the hypercoarse scratches) and Point Hope sample group. For specific microwear feature numbers, please consult Tables 4.1-4.4. Chart aid provided by Stephanie M. Barrante.
Sample Group Breakdown

There are four Point Hope sample groups studied for this thesis: Ipiutak females, Ipiutak males, Tigara females and Tigara males. It was necessary to, at times, combine these four groups in order to gain other types of useful information. For example, the Ipiutak female and Ipiutak male data were combined to assess anterior dental microwear (ADM) for the Ipiutak group as a whole. Likewise, the Tigara female and Tigara male data were combined to calculate ADM for the entire Tigara sample. Additionally, the Ipiutak females and Tigara females were combined as were the Ipiutak males and Tigara males in order to determine female and male ADM totals and percentages, respectively. Please see Table 4.2 for an illustration of these combinations.

<table>
<thead>
<tr>
<th>Groups Studied</th>
<th>Group One</th>
<th>Group Two</th>
<th>Final Group Name</th>
<th>Number of Individuals in Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>Ipiutak Females</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>Ipiutak Males</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>Tigara Females</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>Tigara Males</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Ipiutak Females</td>
<td>Ipiutak Males</td>
<td>Ipiutak</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>Tigara Females</td>
<td>Tigara Males</td>
<td>Tigara</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Ipiutak Females</td>
<td>Tigara Females</td>
<td>Females</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Ipiutak Males</td>
<td>Tigara Males</td>
<td>Males</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 4.2 Sample group breakdown of Point Hope sample groups used in this study. Groups 1-4 represent solitary sample groups while groups 5-8 represent sample groups. Again, Ipiutak male #99.1/196 was omitted due to a high dental microwear count.
Pit Occurrence in the Point Hope Samples

The total number of small, medium and large pits for all four Point Hope sample groups equaled 1298\(^1\). Broken down by community, the Ipiutak group had 714 (55.0%) total pits and the Tigara had 584 (45.0%). In regard to sex, the females possessed 570 (43.9%) total pits while the males had 728 (56.1%) pits. More specifically, the Ipiutak females accounted for 328 (25.3%) total pits, the Tigara females had 242 (18.6%) total pits, the Ipiutak males and Tigara males each had 386 (29.7%) and 342 (26.3%) total pits, respectively (Figure 4.2).

![Total Number of Pits in the Point Hope Sample Groups](image)

Figure 4.2 The total number of pits in the Point Hope sample groups. The total number of pits equals 1298. Thus, the Ipiutak Females possess 25.3% of the total number of pits (this includes all sizes), the Ipiutak Males have 29.7% of the total pits, the Tigara Females have 18.6% of the total pits and the Tigara males have 26.3% of the total number of pits.

\(^1\) This number was computed in the following manner: first, all three separate pit counts for each individual was averaged in order to find the mean number of pits per individual. Each mean per individual was then combined with the means of the individuals in all four sample groups. This provided a total number of pits.
The total number of pits is somewhat similar between all of these sample groups, with the Ipiutak males having the most. The Ipiutak group has 460, 202 and 52 small, medium and large pits respectively, while the Tigara group has 393, 162 and 29 small, medium and large pits respectively. Broken down, this would give the Ipiutak group an average number of 51.1 small, 22.4 medium and 5.8 large pits per Ipiutak individual. It would also give the Tigara group an average number of 39.3 small, 16.2 medium and 2.9 large pits per Tigara individual. See Figure 4.3 for an illustration.

The Ipiutak group as a whole had more small, medium and large pits than the Tigara group as a whole. All ANOVA tests performed between the Ipiutak and Tigara pit totals showed no significant difference (see Appendix C). That is, the ANOVA test performed between Ipiutak small pits vs. Tigara small pits, between Ipiutak medium pits vs. Tigara medium pits and between Ipiutak large pits vs. Tigara large pits showed no significant differences.

Bisected by sex, the females had 294, 231 and 45 small, medium and large pits respectively, while the males had 559, 133 and 36 small, medium and large pits respectively. This would give each individual female an average of 29.4 small, 23.1 medium and 4.5 large pits. It would also give each individual male an average of 62.1 small, 14.8 medium and 4.0 large pits. Please refer to Figure 4.4.
Figure 4.3 Mean pit number between the Ipiutak and Tigara sample groups. This box plot represents the average number of small, medium and large pits per individual in both the Ipiutak and Tigara groups. The colored boxes represent 50% of the values; the line in the box represents the median value. The “whiskers” represent the range of values and the open circles represent those in the sample group that had outlying values.

Although the large pit means were similar between the males and females, the males had over twice as many small pits and the females had nearly twice as many medium pits. Consequently, there was a significant difference in small pits between males and females ($p = 0.0255$) and in medium pits between males and females ($p = 0.0364$). There was no significant difference in large pit means between the males and females (see Appendix C).
Sex

Figure 4.4 Mean pit number between male and female sample groups. This box plot represents the average number of small, medium and large pits per individual in both the male and female sample groups. Again, the open circles represent those in the sample groups that had outlying values.

For the Ipiutak females by themselves, they possessed 169, 137 and 22 small, medium and large pits respectively, giving each Ipiutak female an average of 33.8 small, 27.4 medium and 4.4 large pits. For the Tigara females, they had 125, 94, and 23 small, medium and large pits respectively, giving each Tigara female an average of 25.0 small, 18.8 medium and 4.6 large pits.

For the Ipiutak males by themselves, they had 291, 65 and 30 small, medium and large pits respectively with an average of 72.8 small, 16.3 medium and 7.5 large pits.
The Tigara males contributed 268, 68 and 6 small, medium and large pits respectively, giving each Tigara male an average of 53.6 small, 13.6 medium and 1.2 large pits (see Table 4.3). For an illustration of the Ipiutak females, Tigara females, Ipiutak males and Tigara males, please refer to Figure 4.5.

As shown in Table 4.3, the small and large pit means for the Ipiutak females and Tigara females are similar and there is a small difference in medium pits. All ANOVA tests performed among the small, medium and large pits between the Ipiutak females and Tigara females showed no significant difference between them (see Appendix C).

On the other hand, the Ipiutak males and the Tigara males have similar small and medium pit means. Although there was a difference in large pits means, all ANOVA tests performed among all sizes of pits between the two male groups showed no significant differences (see Appendix C).

<table>
<thead>
<tr>
<th>Group</th>
<th>Small Pits</th>
<th>CV</th>
<th>Medium Pits</th>
<th>CV</th>
<th>Large Pits</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipiutak Females</td>
<td>33.8 ± 26.4</td>
<td>82.0</td>
<td>27.4 ± 10.3</td>
<td>39.5</td>
<td>4.4 ± 3.1</td>
<td>74.0</td>
</tr>
<tr>
<td>Ipiutak Males</td>
<td>72.8 ± 40.7</td>
<td>59.4</td>
<td>16.3 ± 8.5</td>
<td>55.4</td>
<td>7.5 ± 8.4</td>
<td>119.0</td>
</tr>
<tr>
<td>Tigara Females</td>
<td>25.0 ± 20.7</td>
<td>86.9</td>
<td>18.8 ± 7.3</td>
<td>40.8</td>
<td>4.6 ± 3.0</td>
<td>68.5</td>
</tr>
<tr>
<td>Tigara Males</td>
<td>53.6 ± 28.3</td>
<td>55.4</td>
<td>13.6 ± 3.2</td>
<td>24.7</td>
<td>1.2 ± 1.6</td>
<td>140.0</td>
</tr>
</tbody>
</table>

Table 4.3 Mean pit feature counts, broken down by size, with standard deviation. There was a statistically significant difference in small and medium pit means between the males (Ipiutak males and Tigara males) and females (Ipiutak females and Tigara males). Small pit $p$ value = 0.0235, medium pit $p$ value = 0.0364.
Figure 4.5 Mean pit number for each Point Hope Sample group. This box plot represents the average number of small, medium and large pits per individual in all four Point Hope sample groups. Each group had a sample size of five individuals except the Ipiutak male group, which had four individuals.

Fine Scratch Occurrence in the Point Hope Samples

The total number of small, medium and large fine scratches for all four Point Hope sample groups equaled 652. The Ipiutak sample, which again consisted of the Ipiutak females and Ipiutak males, had 241 (37.0.%) of the total fine scratches. The Tigara sample, comprised of the Tigara females and Tigara males, had 411 (63.0.%) of the total fine scratches. The females (Ipiutak females and Tigara females) possessed 322
(49.4%) of the total number of fine scratches, while the males (Ipiutak males and Tigara males) had 330 (50.6%). Broken down, the Ipiutak females had 145 (22.2%) of the total fine scratches and the Tigara females had 177 (27.1%). The Ipiutak males had 96 (14.7%) and the Tigara males had 234 (35.9%) of the total fine scratches. Refer to Figure 4.6.

![Total Number of Fine Scratches of the Point Hope Sample Groups](image)

Figure 4.6 Total number of fine scratches of the Point Hope sample groups. The total number of fine scratches equals 652. Thus, the Ipiutak females had 22.2% of all sizes of fine scratches, the Ipiutak males had 14.7%, the Tigara females had 27.1% and the Tigara males had 35.9%.

The Tigara males have the highest number of fine scratches, with the Tigara females having the next highest. At first glance it may appear that the Tigara group as a whole has a different fine scratch signature than the Ipiutak, but again, this total number must be broken down by size categories in order to acquire a more well-rounded portrait.
The Ipiutak sample has 36, 55 and 150 small, medium and large fine scratches respectively, while the Tigara sample has 80, 102 and 229 small, medium and large fine scratches respectively. Broken down, this would give each Ipiutak individual a mean of 4.0 small, 6.1 medium and 16.7 large fine scratches. Each Tigara individual would have a mean of 8.0 small, 10.2 medium and 22.9 large fine scratches. Please see Figure 4.7 for an illustration.

When broken down by size, once again the Tigara sample has a greater mean of small, medium and large fine scratches. The ANOVA test shows a significant difference in medium fine scratches between the Ipiutak and Tigara samples ($p = 0.0446$). The ANOVAs did not show a significant difference in small and large fine scratches (see Appendix C). Refer to Table 4.7 for more detailed data.
Figure 4.7 Mean fine scratch number between the Ipiutak and Tigara sample groups. This box plot represents the average number of small, medium and large fine scratches per individual in both the Ipiutak and Tigara groups.

When the fine scratch size categories are divided by sex, the females have 51, 76 and 195 small, medium and large fine scratches. The males have 65, 81 and 184 fine scratches. This would give each female a mean of 5.1 small, 7.6 medium and 19.5 large fine scratches while each male would have a mean of 7.2 small, 9.0 medium and 20.4 large fine scratches. Please see Figure 4.8.

The mean number of large fine scratches is virtually identical in both the female and male samples. Although males have a greater mean number of small and medium fine scratches, it is not by a considerable amount. Regardless of the differences in total
mean numbers of fine scratches of all size categories, all ANOVA tests showed no significant differences among size categories between the female and male samples (see Appendix C).

Figure 4.8 Mean fine scratch number between male and female sample groups. This box plot represents the average number of small, medium and large fine scratches per individual in both the male and female sample groups. Again, the sample size for the males equaled 10 (Ipiutak males and Tigara males) and the sample size for females also equaled 10 (Ipiutak females and Tigara females).

For the Ipiutak females alone, they possessed 17 small, 29 medium and 99 large fine scratches while the Tigara females had 34 small, 47 medium and 96 large fine scratches. This gave each Ipiutak female a mean number of 3.4 small, 5.8 medium and
19.8 large scratches and each Tigara female a mean number of 6.8 small, 9.4 medium and 19.2 large scratches (see Table 4.4).

The Ipiutak males had 19 small, 26 medium and 51 large fine scratches and the Tigara males had 46 small, 55 medium and 133 large fine scratches. Each Ipiutak male had a mean number of 4.8 small, 6.5 medium and 12.8 large fine scratches and each Tigara male had a mean number of 9.2 small, 11.0 medium and 26.6 large fine scratches (see Table 4.4 and Figure 4.9).

Table 4.3 shows that the mean number of large fine scratches for both female sample groups is very similar, while the Tigara females possessed nearly twice as many small and medium fine scratches as their Ipiutak counterparts. The Tigara males have over twice as many small fine scratches as their Ipiutak counterparts and nearly twice as many medium and large fine scratches. However, no significant differences were found between any of the size categories between both the Ipiutak females and Tigara females and also between the Ipiutak males and Tigara males (see Appendix C).

<table>
<thead>
<tr>
<th>Group</th>
<th>Small Fine Scratches</th>
<th>C_v</th>
<th>Medium Fine Scratches</th>
<th>C_v</th>
<th>Large Fine Scratches</th>
<th>C_v</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipiutak Females</td>
<td>3.4 ± 4.4</td>
<td>135.9</td>
<td>5.8 ± 2.5</td>
<td>45.3</td>
<td>19.8 ± 13.9</td>
<td>73.7</td>
</tr>
<tr>
<td>Ipiutak Males</td>
<td>4.8 ± 4.3</td>
<td>95.2</td>
<td>6.5 ± 3.1</td>
<td>50.7</td>
<td>12.8 ± 3.4</td>
<td>28.2</td>
</tr>
<tr>
<td>Tigara Females</td>
<td>6.8 ± 6.3</td>
<td>97.3</td>
<td>9.4 ± 5.3</td>
<td>59.2</td>
<td>19.2 ± 16.0</td>
<td>87.5</td>
</tr>
<tr>
<td>Tigara Males</td>
<td>9.2 ± 7.8</td>
<td>89.0</td>
<td>11.0 ± 4.3</td>
<td>41.1</td>
<td>26.6 ± 15.4</td>
<td>60.8</td>
</tr>
</tbody>
</table>

Table 4.4 Mean fine scratch feature counts, broken down by size, with standard deviation. There was a statistically significant difference in medium fine scratches between the Ipiutak (Ipiutak females and Ipiutak males) and Tigara (Tigara females and Tigara males) groups, \( p \) value = 0.0446.
Point Hope Sample Group

Figure 4.9 Mean fine scratch number for each Point Hope sample group. This box plot represents the average number of small, medium and large fine scratches per individual in all four Point Hope sample groups. Each group had a sample size of five individuals.

Hypercoarse Scratch Occurrence in the Point Hope Samples

The total number of hypercoarse scratches (HCS) in the four Point Hope samples groups totaled 27. This includes small and large HCS, as medium HCS were not found during the course of this research. The Ipiutak sample as a whole had 21 (77.8%) of the total number of HCS and the Tigara sample as a whole had the remaining six (22.2%). Divided by sex, the female sample as a whole had 15 (55.6%) of the total number of HCS and the male sample as a whole had 12 (44.4%). Broken down further, the Ipiutak
females had 13 (48.2%) of the total number of HCS, the Tigara females had two (7.4%),
the Ipiutak males had eight (29.6%) and the Tigara males had four (14.8%). See Figure
4.10 for an illustration.

![Total Number of Hypercoarse Scratches (HCS) in the Point Hope Sample Groups](image)

Figure 4.10 The total number of HCS in the Point Hope sample groups. The total number
of HCS equals 27. Thus, the Ipiutak Females possess 48.2% of the total number of HCS
(this includes all sizes), the Ipiutak Males have 29.6% of the total HCS, the Tigara
Females have 7.4% of the total HCS and the Tigara males have 14.8% of the total
number of HCS.

It is evident from Figure 4.10 that the Ipiutak group as a whole possessed the
majority of HCS, with the Ipiutak females having more HCS than any other sample
group. The Ipiutak group as a whole had six small and 15 large HCS and the Tigara
group had one small and five large HCS. This gives each individual Ipiutak sample a
mean of 0.7 small and 1.7 large and each individual Tigara sample a mean of 0.1 and 0.5
large HCS (Figure 4.11).
The Ipiutak group, on average, has more small and large HCS than the Tigara. In fact, the Ipiutak have six times as many small HCS and three times as many large HCS. Consequently, the ANOVA tests showed a significant difference between the Ipiutak and Tigara sample groups in the small size category ($p = 0.0479$). There was no significant difference in large HCS between the two communities (see Appendix C).

![Box plot](image-url)

**Figure 4.11** Mean HCS number between the Ipiutak and Tigara sample groups. This box plot represents the average number of small and large HCS per individual in the Ipiutak and Tigara groups.

When divided by sex, the female sample had four small HCS and 11 large HCS while the males had three small HCS and nine large HCS. Broken down, it would give
each female a mean of 0.4 small and 1.1 large HCS and each male would have a mean of 0.3 small and 1.0 large HCS. Please refer to Figure 4.12.

The mean number of small and large HCS is nearly identical between males and females, with females having a slightly higher mean in both size categories. Accordingly, all ANOVA tests performed between the males and females and each size category provided no significant differences (see Appendix C).

Figure 4.12 Mean HCS number between male and female sample groups. This box plot represents the average number of small and large HCS per individual in both the male and female sample groups.

When broken down even further, the Ipiutak females had four small and nine large HCS and the Tigara females had zero small and only two large HCS. This would
give each Ipiutak female an average of 0.8 and 1.8 small and large HCS respectively. It would also give each Tigara females an average of zero and 0.4 small are large HCS respectively (see Table 4.5).

The Ipiutak males had two small and six large HCS and the Tigara males had one small and three large HCS. This would give each Ipiutak male a mean of 0.5 small and 1.5 large HCS and would give each Tigara male a mean of 0.2 small and 0.6 large HCS (see Table 4.5 and Figure 4.13).

The Ipiutak females have far more small and large HCS than their Tigara female counterparts. Additionally, the Ipiutak males have twice as many small and large HCS than their Tigara counterparts. Nevertheless, all ANOVA tests performed between the Ipiutak females and Tigara females and the Ipiutak males and Tigara males in both size categories returned no significant differences in HCS (see Appendix C).

<table>
<thead>
<tr>
<th>Group</th>
<th>Small Hypercoarse Scratches</th>
<th>C_v</th>
<th>Large Hypercoarse Scratches</th>
<th>C_v</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipiutak Females</td>
<td>0.8 ± 0.8</td>
<td>105.0</td>
<td>1.8 ± 1.5</td>
<td>87.5</td>
</tr>
<tr>
<td>Ipiutak Males</td>
<td>0.5 ± 0.6</td>
<td>127.5</td>
<td>1.5 ± 2.3</td>
<td>162.9</td>
</tr>
<tr>
<td>Tigara Females</td>
<td>0</td>
<td>0</td>
<td>0.4 ± 0.5</td>
<td>131.3</td>
</tr>
<tr>
<td>Tigara Males</td>
<td>0.2 ± 0.4</td>
<td>210.0</td>
<td>0.6 ± 1.3</td>
<td>227.5</td>
</tr>
</tbody>
</table>

Table 4.5 Mean hypercoarse scratch feature counts, broken down by size, with standard deviation. Those without a standard deviation reflect the same count numbers during all three sessions. There was a statistically significant difference in small HCS between the Ipiutak and Tigara groups, \( p = 0.0479 \).
Figure 4.13 Mean HCS number for each Point Hope sample group. This box plot represents the average number of small and large HCS per individual in all four Point Hope sample groups.

Summary

To summarize, there were four statistically significant differences: small pits between females and males, medium pits between females and males, medium fine scratches between Ipiutak and Tigara and small hypercoarse scratches between Ipiutak and Tigara.

Regarding pit occurrence, the Ipiutak sample as a whole possessed more pits than their Tigara counterparts. When bisected by sex, males had a greater number of small
and large pits, while the females had a greater number of medium pits. Consequently, the small and medium pit means were significantly different between males and females. Ipiutak females and Tigara females had similar pit occurrences in all three size categories and Ipiutak males and Tigara males also had similar pit occurrences.

Fine scratch incidence between Ipiutak and Tigara samples provided a significant difference in medium fine scratches, with the Tigara group having a greater number. Males and females had similar fine scratch occurrences. The Ipiutak female and Tigara female samples exhibited a similar large fine scratch occurrence, with the Tigara females possessing a greater (but not significantly greater) number of small and medium fine scratches than their Ipiutak female counterparts. The Tigara males had more small, medium and large fine scratches than the Ipiutak males, although they were not significantly different.

The Ipiutak group as a whole possessed the majority of hypercoarse scratches (HCS). In fact, there was a significant difference in small HCS between the two sample groups. When broken down by sex, males and females exhibited a similar incidence of HCS in both size categories. The Ipiutak females had a higher incidence of both small and large HCS than their Tigara female counterparts, although they were not statistically significant. The HCS incidence between Ipiutak males and Tigara males was similar.
CHAPTER V

DISCUSSION

The incisal microwear data presented in Chapter 4 provides some evidence for what archaeologists have hypothesized about the Ipiutak and Tigara communities. That is, their subsistence strategies were distinct based on four significant differences: small pits by sex, medium pits by sex, medium fine scratches by group and small HCS by group. In addition to dietary analysis, perhaps comments can also be made about the heavy reliance on paramasticatory behaviors, which were most likely in daily use by both communities.

It is important to note that interpretations made from this discussion relate strongly to the two particular sample groups being compared. For example, the comparisons made between Point Hope populations (i.e. between Ipiutak and Tigara) in this study are important for their underlying implications regarding the hypothesized difference in diet between the two groups. Likewise, the comparisons between females and males in this study are also important as they have a core implication for the sexual division of labor in Alaskan Eskimo communities.

For example, the Ipiutak sample group had considerably more hypercoarse scratches (HCS) than the Tigara (21 vs. six), which could support the argument for dietary differences; however, a completely distinct picture is highlighted when the samples are evaluated by sex. When female and male total HCS are compared, the
difference is very minimal (15 vs. 12). This may offer evidence for similar paramasticatory behaviors or paramasticatory behaviors that differ by sex, but produce the same incisal microwear signature.

When the samples groups are broken down by Point Hope community and by sex, the interpretations become quite complex. Are we to attribute a certain dental microwear signature to diet or to paramasticatory behaviors? How are we do know that the microwear signature is not due to a combination of both these factors? The challenge is to isolate important variables such as community, sex, diet and paramasticatory behaviors, especially with skeletal remains with no documented ethnographic record.

In addition to these questions, it is important to remember the type of teeth being analyzed. Although the majority of dental microwear studies examine molars, this study does not, and while using incisors for dental microwear research can provide information that molar research cannot, the opposite is also true. In this instance, incisal microwear research can provide inferences on diet and paramasticatory behaviors, but its usefulness in diet may be quite limited. Incisors are not used for mastication as molars are; instead, they are primarily used for biting and tearing food. Thus, making concrete statements concerning diet in incisal microwear research is approximate.
The total number of pits for the Ipiutak as a whole equaled 714 while the Tigara had 584. When broken down into three size categories, small, medium and large, the Ipiutak had more than the Tigara in all three. Although the ANOVA tests showed these differences to be statistically insignificant, the question arises as to why the Ipiutak had more pits than the Tigara community. There are several possible answers related to both diet and the sexual division of labor.

It is well documented that early 20\textsuperscript{th} century Alaskan Eskimo groups prepared meat, their staple subsistence source, on open racks or stored them underground (Larsen and Rainey 1948). The Point Hope coast, and the location of the sites, is made up of sand. Without doubt, sand in their diet had to have contributed to the amount of small pits found in both groups, with the Ipiutak perhaps having more sand in their food. This increase in sand intake could be due to differences in the location of butchering meat, location of food preparation or the location in which the food was eaten. All of these factors could have contributed to an increase in grit in their diet and thus, an increase in small pits.

As for medium and large pits, it could be suggested that the Ipiutak group as a whole ate more bone than their Tigara counterparts. Small bones, such as fish and bird bones, could have produced the medium and large pits. Large bones, such as those from seal or caribou, most likely would not account for the medium- and large-sized pits, as
even these sizes are quite small in relation to what a large bone could produce if it made contact with an incisor.

When the data is examined in relation to sex, additional inferences arise. As a whole, males had a total number of 728 pits and females had a total of 570. More specifically, the males had a total of 559 small pits while the females had a total of 294 small pits. The males had a total of 133 medium pits and the females had a total of 231. The ANOVA tests showed the differences in small and medium pits between males and females to be statistically significant.

Why do males have a greater number of small pits than females? Since I have attributed small pits to sand or grit in the diet, perhaps males had better access to meat than females. Males hunted sea or land mammals and at times butchered the animal themselves (Giffen 1930). In the course of butchering, the males most likely consumed a portion of the animal prior to bringing it home. One source even noted a situation where an Alaskan Eskimo man killed a caribou, gorged himself and brought nothing home to his family (Giddings 1967).

Why do females have a statistically significant number of medium pits than males? Perhaps the reasoning once again combines both diet and the sexual division of labor. In both coastal and interior Alaskan Eskimo groups, females were recorded catching fish and small birds for their families to eat and for the materials to prepare clothing (Giddings 1967; Gubser 1965). Since females are primarily responsible for obtaining these types of food and clothing products, it stands to reason that they would be
eating these food sources more often than males. Therefore, medium pits could be attributed to eating small bones, such as fish and small birds.

Interestingly, Ipiutak males and Tigara males have similar numbers of small, medium and large pits. As a whole, the Ipiutak males have a total of 386 pits whereas the Tigara males have 342. Broken down by size, the Ipiutak males have a total of 291, 65 and 30 small, medium and large pits respectively. The Tigara males have a total of 268, 68 and six small, medium and large pits, respectively. The ANOVA tests showed no significant differences in their means.

The similarity in pit numbers and means between the Ipiutak males and Tigara males provides interesting information. If one takes Larsen and Rainey's 1948 hypothesis to be true, then paramasticatory behaviors would remain constant between the sexes and diet would vary between communities. Thus, the similarity between these two groups of males may provide evidence for similar paramasticatory behaviors. However, this may not provide the only explanation.

The Ipiutak females have pit totals of 169 small, 137 medium and 22 large while the Tigara females have pit totals of 125 small, 94 medium and 23 large. It is important to note that no significant differences were found between the Ipiutak and Tigara females. All three pit size categories show very similar numbers, just as in the two male groups.

When all four sample groups are looked at as a whole, patterns can be observed. The similar pit numbers between the Ipiutak males and Tigara males and between the Ipiutak females and Tigara females provides insight into potential dietary differences that
are related to the sexual division of labor. For example, the small pit numbers between the two male groups are similar as are the small pit numbers between the two female groups. However, both male groups have an elevated number of small pits when compared with both female groups. As eluded to above, this could provide evidence of males having better access to large game on the coast, whether it was land or sea mammal, consuming a portion of the animal at the kill site, and with it, grit. This alternative idea does not refute Larsen and Rainey’s original hypothesis, but offers another approach to the research at hand. Conversely, both female groups have a much lower incidence of small pits, suggesting they did not consume as much grit.

Both female groups show a much higher incidence of medium pits than in both male groups. Although the ANOVA showed this difference to not be significant, the elevated number of medium pits can provide evidence for females having better access to fish and small birds. Alternatively, one could also suggest that males did not have as much access to these products.

Fine Scratches

For the Ipiutak and Tigara communities as a whole, the Ipiutak had a total of 241 while the Tigara had a total of 411. Although this difference is not as profound as what was found in the pits, it becomes important when it is broken down by size. The Ipiutak totals for small, medium and large fine scratches were 36, 55, and 150. The Tigara totals
for small, medium and large fine scratches were 80, 102 and 229. Although there is not a significant difference in small and large fine scratches according to the ANOVA, there is an important distinction in the medium fine scratch category.

The question arises as to why there is an increase in fine scratches in the Tigara sample generally and why is there a significant difference in medium fine scratches between the Ipiutak and Tigara samples specifically. One idea is that biting and tearing food was creating the fine scratches, but this action would most likely create a more severe type of microwear. Instead, paramasticatory behaviors that have been documented in other Eskimo and Inuit groups may provide a more comprehensive explanation.

As described in Chapter 2, women are documented using their teeth extensively for animal hide preparation and sinew thread production (Ammitzbøll et al. 1991a,b; Foote 1992; Giffen 1930). The mandibular incisors would particularly bear the brunt of these activities as the hides are pushed and pulled along them, creating labial-lingual rounding macroscopically and fine, parallel scratches microscopically (Pedersen and Jakobsen 1989). This could certainly explain the presence of all sizes of fine scratches on the female mandibular incisors; however, what can explain the presence of these fine scratches on male mandibular incisors?

Men have never been associated with hide preparation or sewing activities, so the occurrence of fine scratches cannot be explained by these tasks. Instead, men are also documented using paramasticatory behaviors, by using their teeth to tow seals, soften lines and untangle traces (Giffen 1930). Perhaps one of these behaviors, or another
unrecorded behavior, created the abundance of fine scratches on the Point Hope male incisors.

It is interesting to note that although fine, parallel scratches are associated with female hide preparation, which is a year-round, time-consuming activity, males have slightly more small and medium fine scratches than females. Perhaps large fine scratches are more apt to occur during female hide preparation than small and medium fine scratches.

When broken down by group and sex, the Ipiutak females had more small and medium fine scratches than their Tigara female counterparts. The large fine scratch numbers between the two females groups were very similar, providing evidence to support these types of fine scratches as being associated with animal hide preparation.

The two male groups, alternatively, had differences in their fine scratch numbers. Although not statistically significant, the Tigara male sample had more small, medium and large fine scratches than their Ipiutak male counterparts. Since males are not associated with sewing, the fine scratches would have been created by another behavior that produced fine scratches.

Hypercoarse Scratches

The final dental microwear feature is hypercoarse scratches (HCS). The HCS total for the Ipiutak sample totaled 21 while the Tigara sample totaled six. Broken
down, the small HCS total for the Ipiutak and Tigara was six and one respectively and the large HCS total for Ipiutak and Tigara was 15 and five correspondingly. There was not a statistically significant difference in large HCS between the two communities, but there was a statistically significant difference in small HCS. Tentatively speaking, it may be tempting to state that the marked increase in HCS in the Ipiutak group is related to diet. One idea is that HCS are caused from tearing an amount of food from a larger piece. A second idea is scraping one’s incisors against a bone in order to consume a piece of meat.

Broken down by sex, there is not a statistically significant difference in small and large HCS between males and females. In fact, their numbers are nearly identical. This may suggest that the HCS are not due to the sexual division of labor. Moreover, there is also not a statistically significant difference in HCS between the Ipiutak males and Tigara males, but Ipiutak males did have a higher incidence of both small and large HCS. However, the similarity in HCS incidence in both size categories implies that males did not often partake in dietary or paramasticatory behaviors that produced HCS.

However, the Ipiutak female and Tigara female sample groups did illustrate marked differences, although they were not statistically significant. The Ipiutak female HCS count totaled 13 while the Tigara females had two. The Ipiutak female small and large HCS totals were four and nine respectively and the Tigara female small and large HCS totals were zero and two respectively. Thus, the differences in HCS in the two female groups explain the disparity between the Ipiutak and Tigara samples as a whole.
and the males and females as a whole. However, this still does not clarify what caused small and large HCS in the first place.

The marked incidence of both small and large HCS in the Ipiutak female sample could be attributed to sewing generally and sinew thread production specifically. That is, sinew thread is produced by a back-and-forth motion across the teeth, eventually producing sinew grooves. Perhaps HCS, with their deep, wide and somewhat parallel furrows, are the precursor to sinew grooves.

Perhaps the Ipiutak group, being primarily an interior group, utilized a different type of sinew altogether than the Tigara. A second idea is that the Ipiutak used a certain type of sinew more often than the Tigara. One possibility that comes to mind is that of caribou. If Larsen and Rainey are correct, conceivably the Ipiutak utilized caribou sinew much more often than the Tigara. This sinew thread explanation would also explain why small and large HCS appear on male incisors as well, as women would be producing the sinew thread, but men certainly were using it for everyday tasks.

Research Comparisons

Interesting results arise when this data is coupled with an occlusal molar microwear analysis of the two Point Hope communities. In her research, El-Zaatari (2006) found more pitting and narrower scratches in the Tigara sample than in the Ipiutak. The higher incidence of pitting is attributed to an increase of sand in the Tigara
diet (2006). No cause is given for the narrower scratches. The detection of narrower scratches in the Tigara sample coincides with my research of an increase of hypercoarse scratches in my research, although this is difficult to evaluate since El-Zaatari does not divide the dental microwear into size categories.

The difference in pitting incidence between my research and that of El-Zaatari could have occurred due to several reasons. First, the differences could be accounted for in the type of teeth studied. As mentioned before, molar analysis would better indicate diet whereas anterior dental microwear analysis would provide insight into paramasticatory behaviors as well as diet. Secondly, we used very different methodologies in our research. El-Zaatari used an SEM in converted backscattered electron mode with a magnification of approximately 500X while I used a SMZ-U stereomicroscope with a magnification of approximately 125-150X. Unfortunately, a standard protocol in dental microwear research is yet to be established, making comparisons between studies difficult at best.

Summary

In summary, four of the ANOVA analyses provided statistically significant results. There was a statistically significant difference in small and medium pits between the male and female groups, in medium fine scratches between the Ipiutak and Tigara groups and in small hypercoarse scratches between the Ipiutak and Tigara groups.
By applying data between females and males, one may begin to establish connections between post-contact sexual divisions of labor in Alaskan Eskimo populations and the prehistoric Ipiutak and Tigara communities of Point Hope. Finally, by breaking down these two broad categories into females and males of each community, patterns can emerge, which lead to even more detailed and comprehensive research.

Using data between the Ipiutak and Tigara sample groups, one may be able to either refute or confirm prior archaeological evidence suggesting a difference in subsistence strategies. The course of this research provides no evidence to counter Larsen and Rainey’s original premise that the Ipiutak and Tigara communities relied on different subsistence strategies. That being said, I think there are other possibilities to explain not only the archaeological data, but also the dental microwear data provided here. Did Larsen and Rainey consider the extensive trade between interior and coastal Alaskan Eskimo groups? Did they think about human migration patterns to and from Point Hope? Did they also think about caribou migration patterns to Point Hope and whether it was sufficient to provide the necessary number of caribou for an entire community to not only live on, but also clothe themselves on?

To be brief, did the Ipiutak population rely mainly on land mammals while at Point Hope? Perhaps, but probably not. Did the Tigara population rely chiefly on sea mammals? Almost certainly. After all, Point Hope has been called one of the best whaling locations in the world, and the abundance of what Larsen and Rainey have called “land mammal hunting implements” could be explained in other ways, such as warfare.
The use of teeth in an archaeological context has opened up new avenues for anthropology in general and physical anthropologists specifically. Dental microwear has allowed us to recreate past environments and with them, past behaviors. These data have proven useful in the dietary and paramasticatory behavior reconstruction of the Point Hope communities. Although many ideas have been posited here, a compilation of dental microwear studies, along with experimental archaeology, is imperative in order to confirm or refute them.
CHAPTER VI

CONCLUSION

There are several valuable conclusions this project has brought to the forefront. The most important is the sometimes cloudy relationship between powerful statistical analysis and the tangible numbers. Four of the ANOVA tests performed in this study showed a significant difference between the various means tested; however, analyzing the numbers themselves does provide valuable information.

A second conclusion, and the purpose of this whole study, is that it is evident from the dental microwear signatures that there are differences in the subsistence strategies and paramasticatory behaviors of the two Point Hope communities. With that being said, it is important to consider not only the significant differences between the two groups being compared, but also the similarities as well. The marked number of similarities between sample groups also suggests the differences between them were not as distinct as originally thought.

The exact causes of the dental microwear signatures require additional research, both within the spheres of experimental archaeology in order to pair behaviors and diet to types of dental microwear and in further dental studies combining anterior and posterior dentitions. Incisors provide us one piece of the puzzle, the molars another. Specifically, a molar and incisor microwear study using the same methodology could possibly offer
data that better distinguishes microwear signatures between diet and paramasticatory behaviors.

Additionally, the canines, from my observation, would greatly benefit dental microwear studies in general and would provide additional collaboration for Point Hope researchers. Another potential study would examine the linear enamel hypoplasia incidence of the Point Hope communities. This would better indicate the level of success these specific arctic foragers maintained and would also provide insight into non-specific stress duration.

It is important to encourage additional research on the Point Hope skeletal remains for several reasons. First, alluded to above, it helps anthropologists understand the level of success that these arctic foragers reached in such a harsh environment. In connection to this, it helps us better recognize the biological adaptations that arise in long-term cold stress. A second reason to promote Point Hope research is the impending repatriation issues surrounding the skeletal remains. Once the opportunity to study the Point Hope communities has disappeared, we will have lost integral evidence of successful arctic forager lifeways.

Lastly, I hope this study has opened up new opportunities to students and professionals alike who are interested in new techniques for dental microwear. Traditional dental microwear studies can be tedious and the methodology can be confusing, especially to the novice anthropologist. Light microscopy offers great possibilities and is much more affordable and accessible than a scanning electron
microscope. I recommend testing new techniques that have not been previously explored. Speaking with microscopists and engineers, who can provide access to instruments and machinery unknown to anthropologists, can offer valuable information relating to a project similar to this one.

The results of these collaborations have produced interesting results. The first is the use of light microscopy at a magnification of approximately 125-150X. The microscope used in this study provided better results than that of the scanning electron microscope available to me at Western Michigan University. The second result is the use of gold sputtering when using light microscopy. The dental microwear features were much more distinguishable when gold sputtering was completed. The third and final result of these collaborations is perhaps the most notable: interference microscopy. An interference microscope is traditionally used in mechanical engineering to analyze the wear on mechanical seals, but its use has transcended this original function. It provides surface topography from a field of view ranging from 8.2 by 6.3 mm to 150 by 100 µm. The new technique in dental microwear is confocal microscopy, which also provides surface topography; however, I believe interference microscopy could provide even better data. See Figures 6.1 and 6.2 below for examples of the Veeco NT-1100 system.

In conclusion, I challenge dental anthropologists and graduate students to think beyond the standard methodologies. Although it may require more hours behind a computer screen, at the microscope or introducing yourself to others in departments other than your own, it is well worth the effort.
Figure 6.1 Tigara 359, female, central left incisor. The top photo shows the occlusal surface under a light microscope; the second photo is the surface data; the third photo shows a 3-dimensional display. These bottom two photos were taken with the interference microscope.
Figure 6.2 Ipiutak 96-A, male, central left incisor. See Figure 6.1 for a description of each photo.
REFERENCES


Appendix A

Sex Determination Data
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<td>Tigara</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>Female (2)</td>
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</table>

This graph represents the sex determination data produced at the American Museum of Natural History in New York City. Codes: NC = Nuchal crest, LMasP = Left mastoid process, RMasP = Right mastoid process, LSOM = Left supraorbital margin, RSOM = Right supraorbital margin, LGLAB = Left glabella, RGLAB = Right Glabella, ME = Mental eminence. In scoring each area of the skull, there is a scale from one to five. One indicates a very gracile feature whereas five indicates a very robust feature.
Appendix B

Individual Dental Microwear Data
Mean Ipiutak Female Feature Counts with Standard Deviation. Those without a standard deviation reflect the same count numbers during all three sessions.

<table>
<thead>
<tr>
<th>Burial Number</th>
<th>Pits</th>
<th>Fine Scratches</th>
<th>Hypercoarse Scratches</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.1/83-A</td>
<td>48.0 ± 9.2</td>
<td>16.0 ± 1.0</td>
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<td>99.1/88</td>
<td>103.3 ± 6.4</td>
<td>36.3 ± 3.2</td>
<td>5.3 ± 0.6</td>
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<td>37.0 ± 10.4</td>
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<td>99.1/181</td>
<td>104.3 ± 7.6</td>
<td>45.0 ± 10.5</td>
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Mean Ipiutak Male Feature Counts with Standard Deviation. Those without a standard deviation reflect the same count numbers during all three sessions.

<table>
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<th>Pits</th>
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<th>Hypercoarse Scratches</th>
</tr>
</thead>
<tbody>
<tr>
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<td>99.1/196</td>
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<td>Hypercoarse Scratches</td>
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<td>---------</td>
<td>----------------</td>
<td>-----------------------</td>
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Mean Tigara Female Feature Counts with Standard Deviation. Those without a standard deviation reflect the same count numbers during all three sessions.

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Mean Tigara Male Feature Counts with Standard Deviation. Those without a standard deviation reflect the same count numbers during all three sessions.
Summary Chart of Dental Microwear Features by Individual

This graph represents a summary of dental microwear features by individual. Notice the inclusion of Ipiutak male #99.1/196. This individual was excluded from analysis due to his high dental microwear values.
Appendix C

Results of Two-way Analysis of Variance
### ANOVA Table for PITS

#### Row exclusion: PT HOPE MICROWEAR 10-06

<table>
<thead>
<tr>
<th></th>
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### ANOVA Table for PITS SMALL

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### ANOVA Table for PITS MEDIUM

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### ANOVA Table for PITS LARGE

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### ANOVA Table for FS SMALL
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### ANOVA Table for HYPERCOARSE SCRATCHES

Row exclusion: PT HOPE MICROWEAR 10-06

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### ANOVA Table for HCS SMALL

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### ANOVA Table for HCS LARGE

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